GEOGRAPHICAL HANDBOOK SERIES FOR OFFICIAL USE ONLY

GERMANY

VOLUME IV

NAVAL INTELLIGENCE DIVISION

B.R. 529C (Restricted)

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PORTS AND COMMUNICATIONS

May 1945

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PREFACE

IN 1915 a Geographical Section was formed in the Naval Intelligence Division of the Admiralty to write Geographical Handbooks on various parts of the world. The purpose of these handbooks was to supply, by scientific research and skilled arrangement, material for the discussion of naval, military, and political problems, as distinct from the examination of the problems themselves. Many distinguished collaborators assisted in their production, and by the end of 1918 upwards of fifty volumes had been produced in Handbook and Manual form, as well as numerous short-term geographical reports. The demand for these books increased rapidly with each new issue, and they acquired a high reputation for accuracy and impartiality. They are now to be found in Service Establishments and Embassies throughout the world, and in the early years after the last war were much used by the League of Nations.

The old Handbooks have been extensively used in the present war, and experience has disclosed both their value and their limitations. On the one hand they have proved, beyond all question, how greatly the work of the fighting services and of Government Departments is facilitated if countries of strategic or political importance are covered by handbooks which deal, in a convenient and easily digested form, with their geography, ethnology, administration, and resources. On the other hand, it has become apparent that something more is needed to meet present-day requirements. The old series does not cover many of the countries closely affected by the present war (e.g. Germany, France, Poland, Spain, Portugal, to name only a few); its books are somewhat uneven in quality, and they are inadequately equipped with maps, diagrams, and photographic illustrations.

The present series of Handbooks, while owing its inspiration largely to the former series, is in no sense an attempt to revise or re-edit that series. It is an entirely new set of books, produced in the Naval Intelligence Division by trained geographers drawn largely from the Universities, and working at sub-centres established at Oxford and Cambridge. The books follow, in general, a uniform scheme, though minor modifications will be found in particular cases; and they are illustrated by numerous maps and photographs.

The purpose of the books is primarily naval. They are designed first to provide, for the use of Commanding Officers, information in a

comprehensive and convenient form about countries which they may be called upon to visit, not only in war but in peace-time; secondly, to maintain the high standard of education in the Navy and, by supplying officers with material for lectures to naval personnel ashore and afloat, to ensure for all ranks that visits to a new country shall be both interesting and profitable.

Their contents are, however, by no means confined to matters of purely naval interest. For many purposes (e.g. history, administration, resources, communications, etc.) countries must necessarily be treated as a whole, and no attempt is made to limit their treatment exclusively to coastal zones. It is hoped therefore that the Army, the Royal Air Force, and other Government Departments (many of whom have given great assistance in the production of the series) will find these Handbooks even more valuable than their predecessors proved to be both during and after the last war.

J. H. GODFREY
Director of Naval Intelligence
1942

The foregoing preface has appeared from the beginning of this series of Geographical Handbooks. It describes so effectively their origin and purpose that I have decided to retain it in its original form.

This volume has been prepared for the Naval Intelligence Division at the Cambridge sub-centre (General Editor, Dr H. C. Darby). It has been mainly written by Mr A. C. O'Dell and Mr F. W. Morgan, with contributions from Mr A. Constant, Dr W. O. Henderson, Mr H. A. P. Jensen, Mr F. J. Monkhouse, and Dr A. F. A. Mutton. The maps and diagrams have been drawn by Mr A. O. Cole, Miss S. H. C. Collins, Miss K. S. A. Froggatt, Mrs Marion Plant, and Miss J. D. I. Tyson. The volume has been edited by Mr F. W. Morgan.

E. G. N. RUSHBROOKE
Director of Naval Intelligence

May 1945

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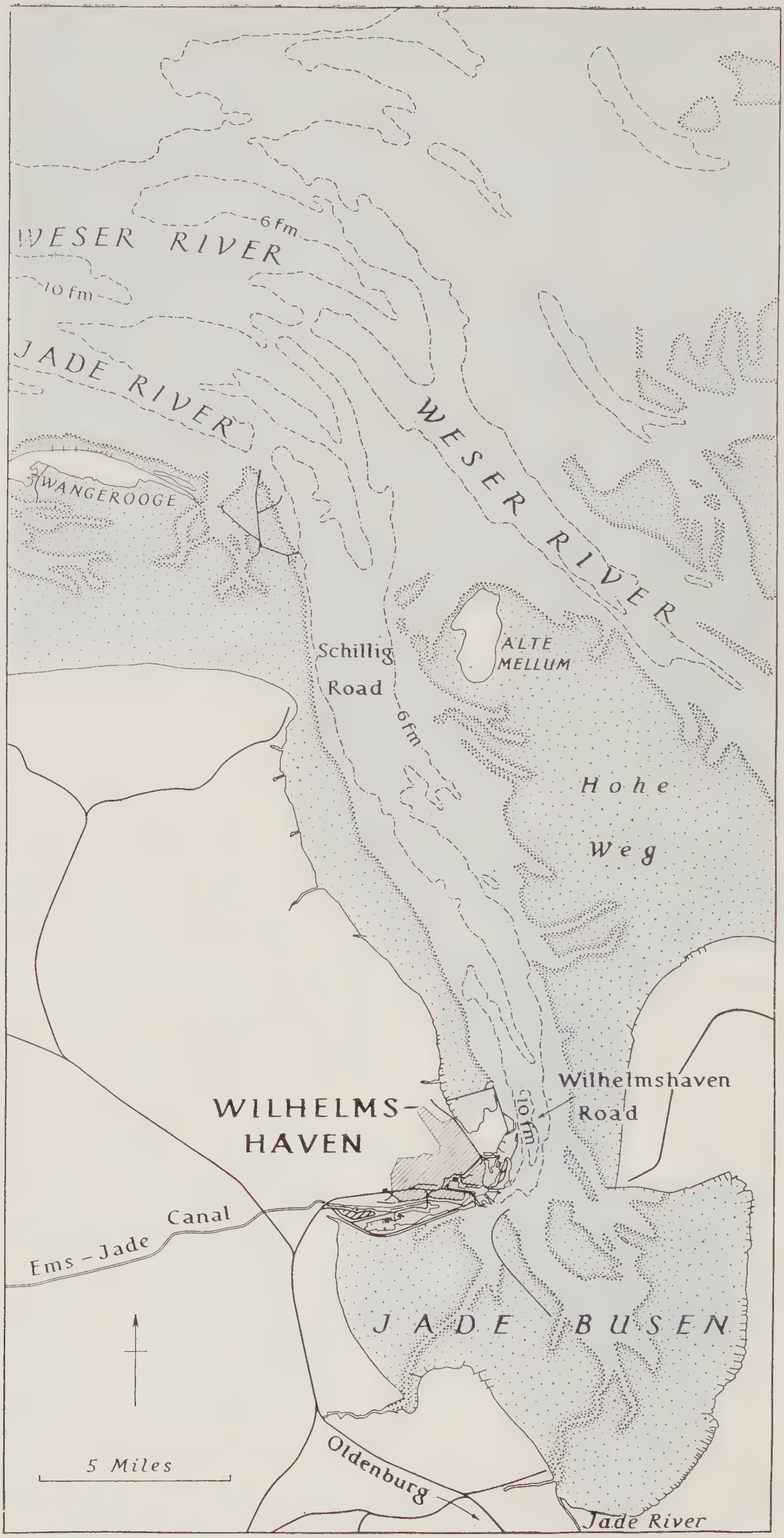

Fig. 1. The approaches to Wilhelmshaven
Based on official sources.

Chapter I

THE NORTH SEA PORTS

Introduction : Emden : Wilhelmshaven : Bremerhaven : Blexen, Nordenham, Brake, Blumenthal, Vegesack : Bremen : Cuxhaven : Hamburg

Introduction

The German ports include one of the largest in Europe, and several of considerable size. Bremen, Germany's second port, is one of the largest on the North Sea, after the great 'world ports' of London, Antwerp, Rotterdam and Hamburg. Stettin, on the Baltic, handles more cargo than Bremen itself, but less than the group of ports on the Weser estuary—Bremen, Vegesack, Blumenthal, Brake, Nordenham, Wesermünde and Bremerhaven. Of all ports at which more than 100,000 net tons of shipping enter annually, ten lie on the North Sea coast, accounting for 34 million tons of shipping entered, and ten lie on the Baltic coast, accounting for only 12 million tons. Hamburg alone handles more cargo and more shipping than all the Baltic ports together.

The type of traffic using the ports of the North Sea coast is very different from that of the Baltic ports. Hamburg, Bremen and their subsidiaries deal with all the long-distance passenger trade and most of the deep-sea cargo vessels. Practically all the imports of tropical produce and of petroleum pass through them, as well as considerable quantities in every other trade. The Baltic ports have a much more restricted type of traffic: they deal primarily with short-sea cargo vessels trading to the Baltic countries. Passenger traffic is mainly represented by the train ferry services to Denmark and Sweden from Rostock (Warnemünde) and Sassnitz. Emden is hardly typical of the North Sea ports, and in its dependence on the iron ore traffic from Sweden looks east rather than west.

Coastwise traffic, by both tramp and liner, is well developed, serving the ports of each coast and forming a connexion between the two, through the Kiel Canal. Most of the coastwise trade is operated by German ships. Of the total entries of shipping in 1937, about one quarter was accounted for by the coastwise trade.

The official German navigation returns list several hundred ports,

but many of these are very small, and a number have no traffic in the course of a year. The returns of port trade give totals of cargo discharged and loaded for 92 ports. In the following account 25 ports are described, being those at which over 100,000 tons net of shipping entered in 1937, together with five of special interest—Vegesack,

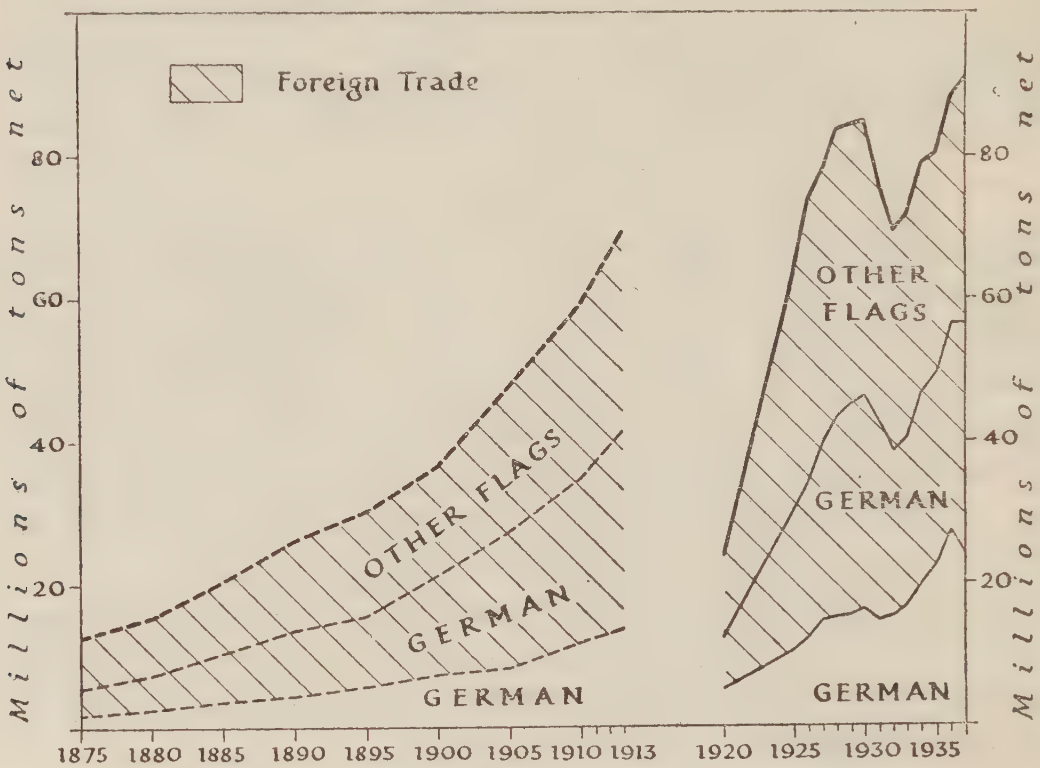

Fig. 2. The growth of traffic at German ports, 1875–1937

Based on data from *Die Seeschiffahrt im Jahre 1937*, Heft II, p. 15 (Berlin, 1939). The graphs show that after the war of 1914–1918 traffic quickly recovered, and in 1926 exceeded the 1913 traffic. After 1926, however, the increase was much less rapid than it had been in the three years before 1913. The effects of the world economic depression stand out clearly enough. Broadly speaking, in the foreign trade the German flag has accounted for an increasing share of traffic since 1875. In the coastwise trade practically all ships were under the home flag. The proportion of coastwise to foreign traffic has risen markedly, more especially since 1905 (the Kiel Canal was opened in 1895).

Note: after 1920 the graphs are plotted for yearly intervals, before that date for five-yearly intervals.

Blexen, Stralsund, Elbing and Pillau. This number includes the two great naval bases of Wilhelmshaven and Kiel. (See page 3.)

There is no German port which specializes in passenger traffic, like Plymouth or Cherbourg. Bremerhaven is the chief port for fast liners, having replaced Cuxhaven in this respect. The figures of tonnage for Rostock (Warnemünde) and Sassnitz are inflated by the Baltic train ferry services.

Movement of shipping, 1937 (*in thousands of net * tons*)

	Inwards		Outwards		Grand total
	Loaded	Total	Loaded	Total	
Hamburg	18,364	19,616	15,664	19,661	39,277
Bremen	5,386	6,407	5,820	6,413	12,820
Stettin	2,589	3,380	2,068	3,371	6,751
Bremerhaven	2,823	2,853	2,538	2,886	5,739
Emden	1,711	2,818	1,853	2,789	5,507
Sassnitz	2,464	2,527	2,517	2,523	5,050
Rostock (Warnemünde)	1,765	1,803	1,741	1,805	3,608
Königsberg	1,288	1,330	498	1,334	2,664
Kiel	1,205	1,232	879	1,151	2,383
Lübeck	929	1,082	548	1,116	2,198
Cuxhaven	851	854	625	631	1,485
Nordenham	209	565	564	595	1,160
Brake	207	298	130	254	552
Wilhelmshaven	244	252	96	247	499
Wismar	127	146	47	148	294
Flensburg	133	145	43	147	292
Kolberg	99	116	85	116	232
Stolpmünde	99	112	64	112	224
Brunsbüttel	99	105	24	103	208
Stralsund	44	74	56	69	143
Blumenthal	99	101	27	30	131

From: *Statistisches Jahrbuch 1938*, p. 227 (Berlin, 1938).

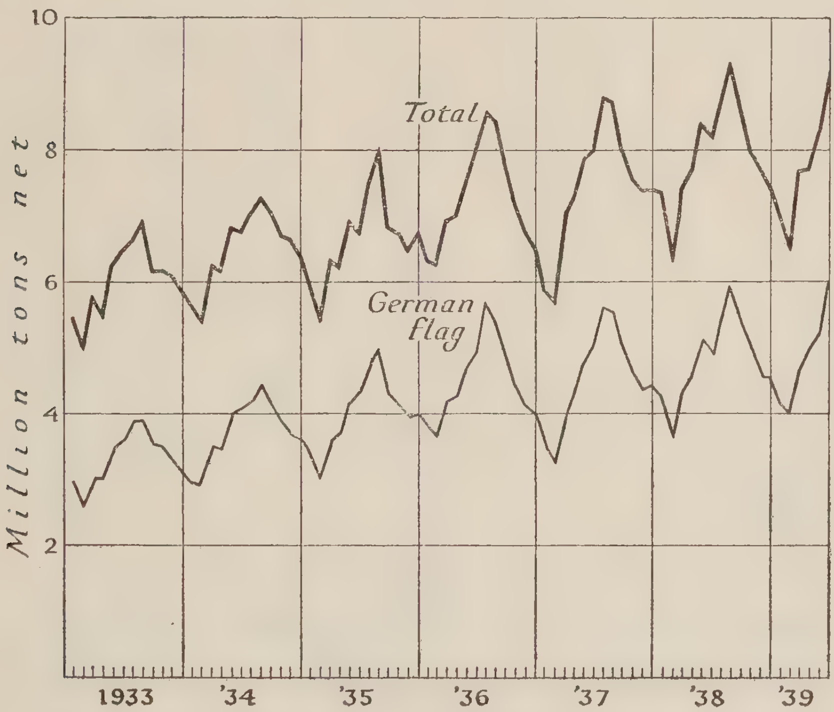

Fig. 3. Traffic at the leading German ports, 1933–9
Based on *Wirtschaft und Statistik*, vol. 19, p. 587 (Berlin, 1939).
These graphs are plotted for monthly intervals.

* See Appendix III.

The cargo trade at these ports showed a very great range in amount.

Cargo movements at principal German ports, 1937
(in thousands of tons)

	1937					1936 Total
	Total	Coastwise		Foreign		
		Outwards	Inwards	Outwards	Inwards	
Hamburg	25,257	1,547	1,379	7,041	15,290	22,027
Stettin	8,330	827	1,646	2,631	3,227	8,368
Bremen	7,458	609	664	4,062	2,122	6,221
Bremerhaven	623	18	35	64	505	555
Wesermünde	45	6	8	1	30	49
Emden	8,014	2,445	107	1,591	3,868	7,943
Königsberg	3,689	656	1,225	219	1,558	4,585
Lübeck	1,995	108	470	525	892	2,161
Nordenham	1,212	133	45	937	98	1,161
Brake	680	85	62	161	372	318
Kiel	639	50	279	19	290	547
Rostock	451	42	64	173	171	422
Ferry	*156*	—	—	*101*	*55*	*121*
Sassnitz	434	183	27	140	85	386
Ferry	*224*	—	—	*139*	*85*	*180*
Wilhelmshaven	421	11	142	5	264	262
Flensburg	269	15	89	40	124	259
Elbing	267	41	192	1	34	361
Brunsbüttel	236	17	95	4	120	284
Stolpmünde	235	37	56	34	108	224
Kolberg	225	64	83	30	48	139
Wismar	221	49	23	22	127	215
Stralsund	189	53	43	53	40	227
Cuxhaven	40	11	17	2	10	35
Pillau	33	—	31	—	2	30
Swinemünde	29	3	19	—	8	14
Blumenthal	23	1	15	1	6	24

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4 (Berlin 1939).

Note: throughout this volume, except where otherwise stated, 'tons' are metric tons of 2,204 lbs.

Fourteen other ports each handled over 50,000 tons of cargo (inwards and outwards together)—Borkum (154,000), Glückstadt (52,000), Heiligenhafen (59,000), Husum (64,000), Itzehoe (110,000), Kappeln (62,000), Karlsminde in Waabs (137,000), Lebbin (89,000), Leer (69,000), Neustadt in Holstein (65,000), Norderney (112,000), Rendsburg (164,000), Rügenwalde (61,000), Schwarzenhütten in Warstade (50,000). Eight of these lie on the North Sea coast, and all, with the exception of Rendsburg, engage chiefly or almost

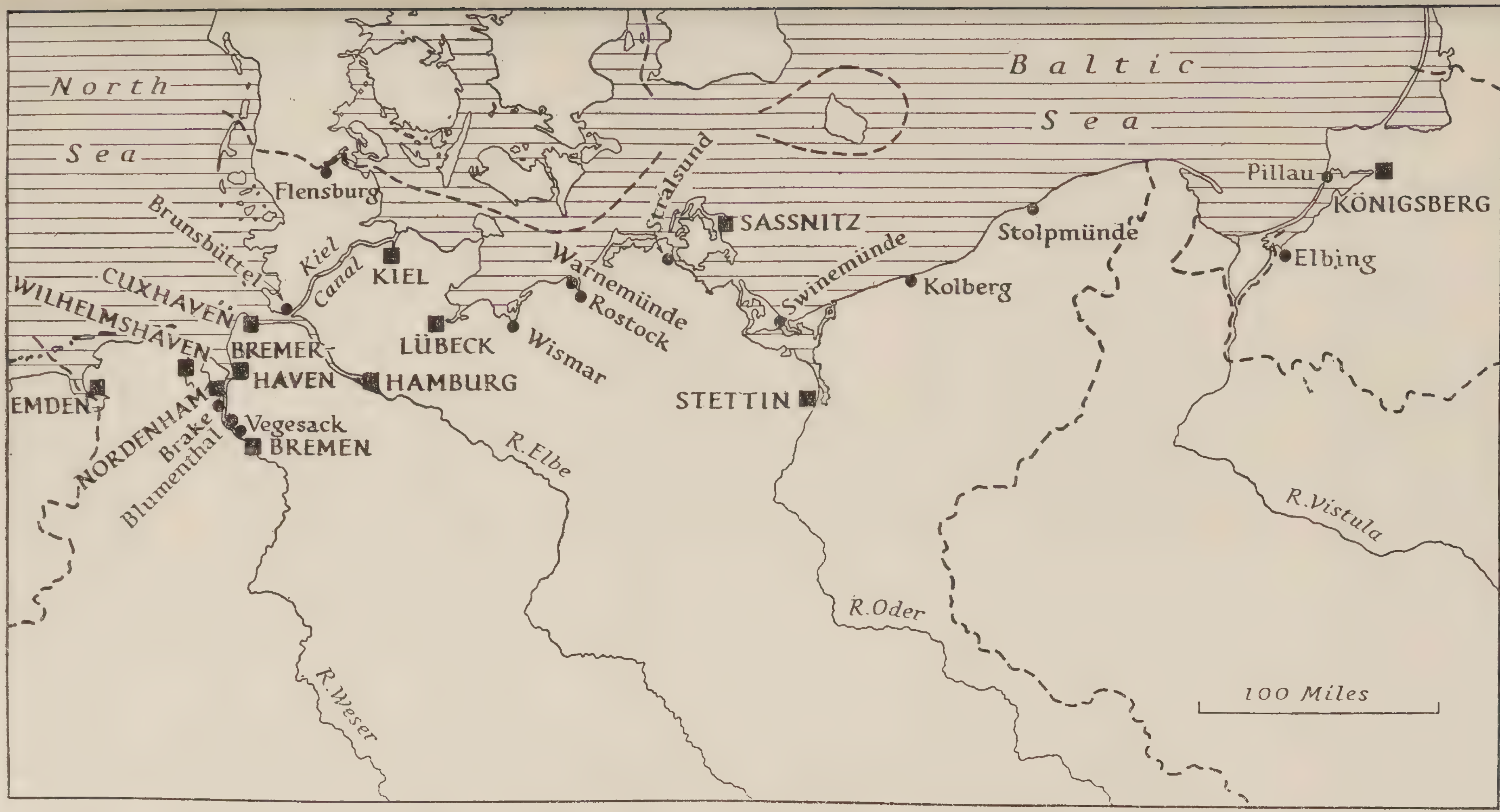

Fig. 4. The location of the chief German ports

Twenty-six ports are named—twenty of these had more than 100,000 net tons of shipping entered in 1937: the remaining six are Vegesack, Warnemünde, Stralsund, Swinemünde, Elbing and Pillau.

entirely in coastwise trade. Fifty-three other ports handled less than 50,000 tons of cargo.

Technically, the port works in Germany contain only a few features of outstanding interest. The basin systems of Bremen and Hamburg are impressive in size and ramification, and the wet-dock system of Wilhelmshaven is one of the largest in Europe. The Kiel C. and its locks form an impressive engineering achievement. The great estuaries of the Weser and Elbe demand considerable investigation of silting and bank movements. The maintenance of the channels in the approaches to Stettin and to Pillau and Königsberg have involved interesting studies of the process of deposition at river mouths in tideless seas, and the maintenance of the channel to Königsberg has been complicated by the shift of the dominant exit of the Vistula. All the ports of Germany lie on the shores of the North European plain; their sites are on the younger and softer rocks, so that port construction work has presented problems different from the problems met with in many West European and Mediterranean ports.

The moderate range of the tides along the North Sea coast has permitted commercial traffic to be carried on largely without the use of wet-docks. At Emden the heavy traffic is served by a wet-dock, and also at the lower docks of Bremen, and at Bremerhaven. Much general traffic at Bremen, and all traffic at Hamburg, however, uses tidal basins. The North Sea naval base of Wilhelmshaven depends entirely upon wet-docks. All the Baltic ports employ open basins.

Administration

Most German ports are under the administration of municipal or government bodies, although for the administration of some ports, e.g. Stettin, private companies established according to civil law have been appointed. These companies, however, are subject to very close supervision by the authorities. In fact, public control is secured at all ports important for general traffic. Some legal and transport authorities have urged the establishment of self-governing boards, like the Port of London Authority, for the administration of the larger ports in Germany.

EMDEN (Figs. 5, 6; Plate 1)

53° 22′ N., 7° 13′ E. Population: 34,200 (1938)

Emden is the most westerly German seaport. It lies on the north

bank of the river Ems, about 28 miles from the mouth. Emden is only a secondary port in size but is well equipped. Its history is short, for development could only follow the opening of the Dortmund-Ems C., which provided a connexion with the Ruhr, and enabled it to handle imports of iron ores and exports of coal.

Approach and Access

From the North Sea three buoyed channels lead south-eastwards to a point off the south-western side of the island of Borkum. The southern entry—Hubertgat Channel—has a least depth of 30 ft. at the inner end of the channel. Though the deepest, this channel is less used than the central channel—Westerems, which has a least depth of 23 ft. The northernmost channel, Riffgat, has a least depth of 15 ft., and is navigable only by small craft and in daylight. All three channels, particularly the Riffgat, are subject to frequent changes of depth.

From the south-west side of Borkum the main fairway up the Ems to Knock lies through Randzelgat, and thence through Doekegat and Oostfriesischer Gat. A least depth of 21 ft. was maintained by dredging, but the channel is narrow and liable to frequent changes.

Anchorage. With westerly or north-westerly winds large vessels may anchor in depths of 72 ft. in the Randzelgat Channel about $1\frac{1}{2}$ miles south-east of Borkum New Lighthouse. For small vessels there is good anchorage in depths of 18–24 ft. in the Bocht van Watum, 3 miles north of the Dutch port of Delfzijl.

Weather and Tides. The port is well sheltered from all winds. During severe winters ice may form, but never sufficiently to dislocate the port traffic.

M.H.W.S.	11·27 ft.
M.L.W.S.	0·000 ft.
Mean level	5·80 ft.

Detailed Description

The port is entered in 25 ft. of water between two short moles 750 ft. apart. It comprises four main sections—Neuer Binnenhafen, Aussenhafen, Binnenhafen and Industrie Hafen. Accommodation at Emden may be summarised as follows:

Berths available

Average length, ft.	Min. depth, ft.	No. of berths	
		Alongside	On dolphins or at anchor—approximate
600	30	—	—
450	26	7	15
450	20	2	2
350	20	10	10
250	16	13	1
200	12	16	—

Neuer Binnenhafen. From the entrance moles Vorhafen leads east-north-east. Berthing is possible in Vorhafen in depths of 23 ft. along a row of dolphins which lie about 100 ft. off the west side. Admission to the Neuer Binnenhafen is by the New Lock (Neuer Emdener Schleuse), 853 ft. long, 131 ft. wide and with a sill depth of about 33 ft. The gates of this lock are roller gates, each weighing 835 tons. The time taken to open or shut the gates is usually $2\frac{1}{2}$ minutes.

Neuer Binnenhafen has an area of about 126 acres, and is capable of further extension. It is the deepest dock in the port, with a depth over most of its area of $30–34\frac{1}{2}$ ft. The northern arm leads by a passage (131 ft. wide and with a least depth of 30 ft.), crossed by a swing bridge, to Industrie Hafen. On the south side of the dock (Erzkai and Eisenkai) there is 2,500 ft. of quayage, equipped with 14 loading bridges carrying slewing cranes: four of these have a capacity of 9 tons, and ten have a capacity of $12\frac{1}{2}$ or 15 tons.* On the north side of the eastern arm there is about 1,000 ft. of quayage with 4 loading bridges. These facilities are specialized and are really only suitable for the working of coal and ore cargoes. Dolphins provide further berthing in this dock: these are situated mainly along the western side of the northern arm, although some are found in the centre of the eastern arm.

Aussenhafen. With a direct entrance from the river Ems, this tidal basin is about 4,600 ft. long, and has a general width of 400 ft. Depths diminish from about 23 ft. at the southern or seaward end to about 17 ft. at the northern end. Only the west side of the basin is quayed—for about 3,000 ft. Railway facilities are good, but road exits bad. There are seven $3\frac{1}{2}–5$ ton electric travelling cranes, one

* Details of cranage in this and the following chapter are taken from official sources dated 1940.

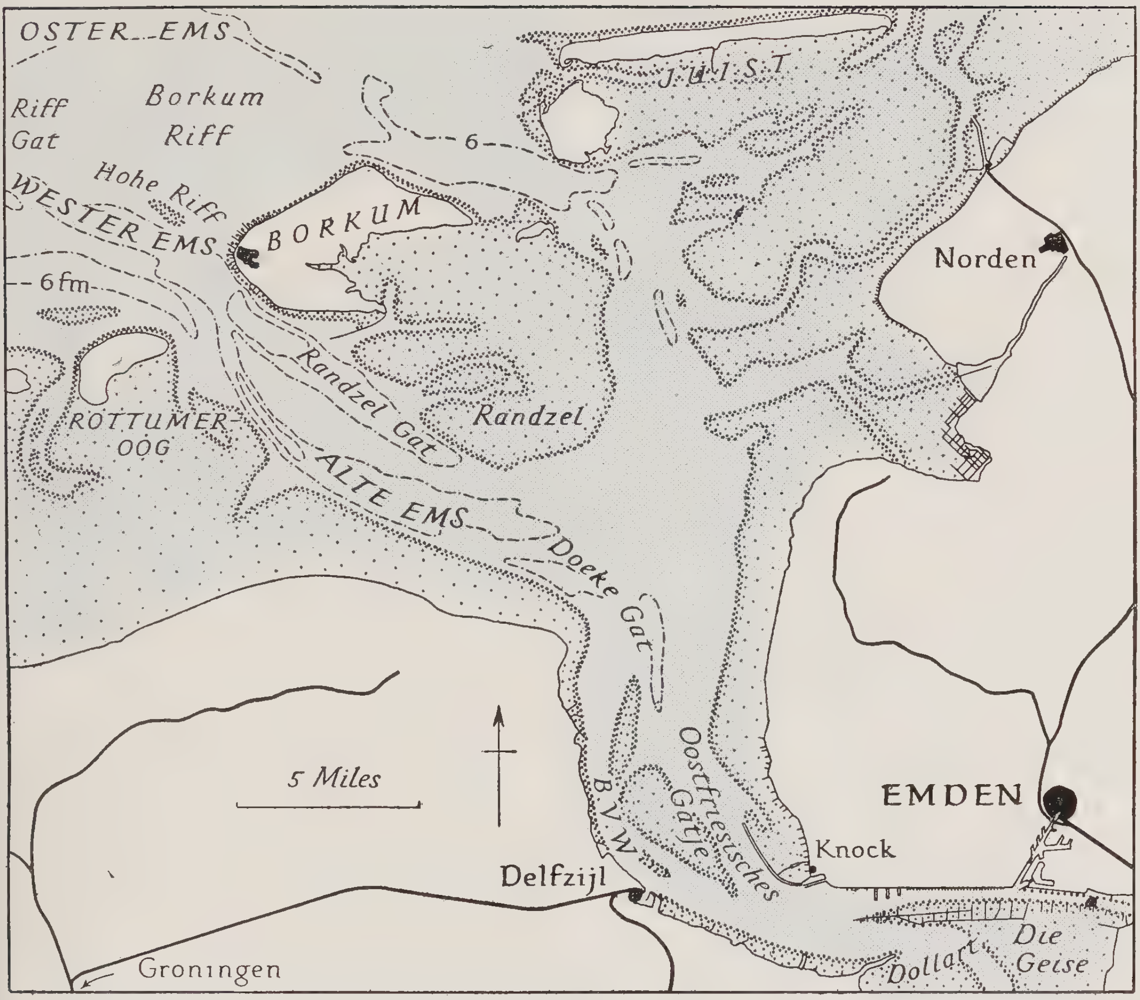

Fig. 5. The approaches to Emden
Based on official sources.
B.V.W. Bocht van Watum.

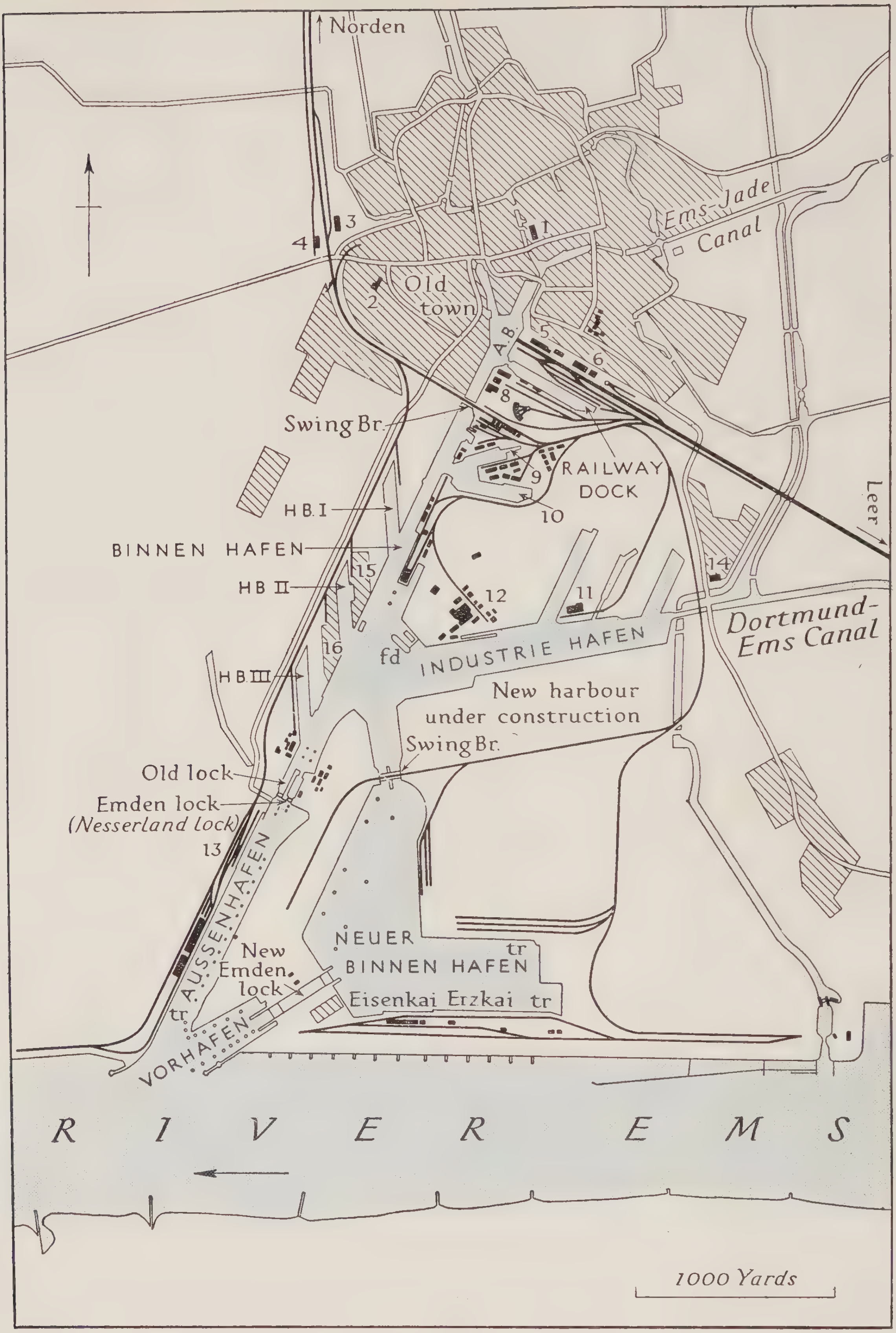

Fig. 6. Emden

Based on official sources.

A.B. Alter Binnenhafen; H.B. Hafenbecken; fd Floating dock; tr Transporters; 1 Port and Telegraph Office; 2 Post Office; 3 W. Station; 4 Light railway station; 5 Customs; 6 Station; 8 Prussian government harbour office; 9 Slip (Alter Liegehafen); 10 Neuer Liegehafen; 11 Patent fuel works; 12 *Nordseewerke*; 13 E. Aussenhafen station; 14 Transformer station; 15 Repair yard; 16 Fishery buildings.

40-ton fixed cantilever, four loading bridges (two 5-ton, two 10-ton), and three grain elevators at a silo. The east side of the basin has some berthing, while along the whole length there is a row of dolphins about 110 ft. from the side. Discharge or loading here must be carried out by ships' gear.

Binnenhafen. This dock is entered by the Nesserland lock (Emden Seeschleuse), which lies alongside an old disused lock. The Nesserland lock, which has double mitred gates, has an effective length of 318 ft., a width of 47½ ft., and a depth on the sill of 22 ft. The Binnenhafen is about 6,000 ft. long, with depths of 23 ft. in the central part and 17 ft. in the northern part. There are no cranes on the western side: quayage amounts to about 1,200 ft., together with 400 ft. of berthage on dolphins. Opening off this side are three small basins—Hafenbecken I, II, III, used by fishing craft and barges.

On the east side of the Binnenhafen there is about 1,700 ft. of quayage, and on the Zungenkai there are three 3¼-ton (?) electric gantries. Behind this quay lies a short cut used by the *Nordseewerke* shipbuilding yard. A wide opening leads eastwards into the Industrie Hafen and also into the Neuer Binnenhafen.

Smaller Basins. Several small basins branch off at the northern extremity of Binnenhafen, all used by barges. Eastwards are Neuerliegehafen and Alter Liegehafen, while northwards, beyond the railway bridge, is the Alter Binnenhafen and the wet-dock which branches from it—Railway Dock.

Industrie Hafen. About 4,500 ft. long and with a width varying from 700 ft. to 300 ft., this basin has a depth of 30 ft. over the greater part. At the west end, fronting also on the Binnenhafen, is the *Nordseewerke Emden* shipyard. Farther east two small basins for barges branch off to the north. At the eastern end of Industrie Hafen is the entrance to the Dortmund-Ems C. (see p. 586). Along the south side works are in progress to extend the basin.

Port Facilities

There are no dry docks. Floating docks number three; the largest is situated at the *Nordseewerke*, and is 410 ft. long, with an inside width of 55 ft. The other two are 220 ft. and 200 ft. long respectively. There are three slipways at *Nordseewerke* (550 ft., 525 ft., 525 ft.), as well as several others, smaller in size.

Nordseewerke Emden G.m.b.H. is a subsidiary of *Vereinigte Stahlwerke A.G.* Besides the three slips mentioned above, this yard has considerable machine, plate and assembly shops. The yard normally

builds cargo ships, pontoons and caissons. In recent years vessels of 6,000 tons were constructed, although 11,000 ton vessels have been built in the past. *Schulte und Bruns* and *Cassens* are small yards which build vessels up to 340 and 166 tons respectively. The *Staatswerft* is a government-operated yard for the repair of inland waterway craft.

The Town

Emden lies in the north-west corner of the Reich, close to the frontier of the Netherlands, and in many ways it resembles an old Dutch town. The twentieth-century outer docks of the port lie near the shore of the estuary of the river Ems, but the town is some two miles inland to the north. In the middle ages Emden lay on the river Ems, but in the sixteenth century the course of the river changed. Medieval Emden developed originally from a number of villages on the *Marsch* land that borders the estuary. The chief districts of the old town (*Innenstadt*) were the Altstadt, the Nordfaldern, the Südfaldern and the Mittelfaldern. The old town was circular in shape and was surrounded by walls. Notable buildings that have survived from the middle ages and the period of the Renaissance are the *Grosse Kirche* (twelfth century), the late Gothic *Gasthauskirche* of a former Franciscan friary, the *Klunderburg* (fifteenth century) and the Town Hall (1576). The Town Hall contains a large collection of medieval armour and weapons. Several canals run through the town.

The modern expansion of Emden has been to the south-west along the quays and docks. The town and the new twentieth-century outer harbour are linked by services of trains, trams and motor boats.

Emden is a municipal borough (*Stadtkreis*), 10·5 sq. miles in area, in the *Regierungsbezirk* Aurich of the Prussian province (formerly kingdom) of Hanover. It has administrative functions in the Reich and in Prussia. The Reich organs of administration include those for finance (*Finanzamt*), customs (*Hauptzollamt*) and cables (*Kabelamt*). In Prussia, Emden is the headquarters of the administration of the rural district (*Landkreis*) of Emden which has an area of 122·7 sq. miles and a population of 23,900.

The town has been very severely damaged by air attacks during the war and the whole of the centre will have to be rebuilt.

History

In the twelfth century Emden (known also as Emutha, Ehemute,

Emünden and Emsmünden) was the capital of the County of Ems which was one of the three districts into which East Friesland was divided. The territory was acquired by the Bishops of Münster, but the town soon gained a position of semi-independence. Emden first flourished as a port and commercial centre towards the end of the fourteenth century when Provost Hisko allowed a band of pirates, called the *Viktualienbrüder*, to trade there after it had been driven from the Baltic by the Teutonic Order. The pirates, however, were defeated off Heligoland by a Hamburg fleet in 1402. Then in 1431 Hamburg and her allies occupied Emden. In the middle of the fifteenth century, however, the control of the port again passed into the hands of the Counts of Friesland.

A new period of commercial prosperity followed the Imperial grant of staple privileges in 1494. In the middle of the sixteenth century the Reformation was introduced into Emden and many Protestant refugees from the Low Countries settled in the town. This influx was of considerable benefit to Emden. Further advantages resulted when, in 1563, the English Merchant Adventurers moved their staple from Antwerp to Emden for a time. Emden became a Free City of the Empire in 1595, but it was not strong enough to maintain its independence and in the seventeenth century it had first a Dutch and then a Brandenburg garrison to 'protect' it.

The occupation of Emden—and of the neighbouring fortress of Greetsiel—by the forces of the Great Elector of Brandenburg is of interest, since Brandenburg took the opportunity afforded by the possession of a North Sea port to found a small colonial empire. In 1662 the Great Elector set up an African Commercial Company which sent negro slaves from its Gold Coast stations to St Thomas in the West Indies. He also set up an East India Company. His successor bought part of the West Indian island of Tobago. But the rivalry of stronger colonial Powers ruined these ventures, and Brandenburg-Prussia sold her West African possessions to Holland.

Frederick the Great of Prussia added East Friesland (including Emden) to his possessions in 1744. He made Emden a free port in 1751. It enjoyed a temporary boom in shipping and trade in the early years of the wars of the French Revolution and Napoleon (1795–1804). This prosperity was destroyed, however, by the establishment of the Continental System. In 1804 the French occupied Meppen and so prevented English goods sent to Emden from reaching markets in the centre of Germany such as Frankfurt-am-Main. In 1810 Emden was annexed to the French Empire and

became the administrative centre of the Department of Ems Oriental. Strong forces under Oudinot were stationed in the port to maintain the Continental System and to guard the French lines of communication between the Low Countries and the Hansa towns. At the end of the Napoleonic Wars Prussia naturally wished to recover East Friesland, but eventually it fell to Hanover while Prussia received territorial compensation elsewhere. This arrangement was not welcomed by the inhabitants of East Friesland. When Prussia annexed Hanover in 1866 East Friesland was recovered.

In the nineteenth century, particularly after it became part of Prussia once more, Emden developed as a port and as a centre of commerce and communications. The railway from Münster had reached Emden in the fifties. The original inner harbour (Alter Binnenhafen) on the southern edge of the old town was improved. A new inner basin (Neuer Binnenhafen) and an Industrial Harbour (Industriehafen) were built, and an ambitious plan for the construction of a new outer port (Aussenhafen) was completed in 1901.

As a centre of communications Emden is important as the terminus of two canals. The first to be built was the Jade-Ems C. (completed in 1887) which links Emden with the naval base of Wilhelmshaven. The second was the great Dortmund-Ems C. of 1892 (and its Rhine-Herne extension of 1914). This waterway joins Emden to the industrial areas of the Ruhr and the Rhine. Cargoes moved on the Dortmund-Ems C. increased from 1,000,000 tons in 1903 to 8,793,000 tons in 1928 (see p. 586). Exports of Ruhr coal from Emden amounted to over 1,500,000 tons in 1913.

Emden also became important as the terminus of submarine cables to England and to North and South America. In 1900 the first direct cable from Germany to North America was completed and it ran from Emden to Vigo, the Azores and New York. Then the German South American Telegraph Company (founded at Köln in 1908) laid a cable from Emden to Teneriffe, Monrovia and Pernambuco —with a subsequent extension from Monrovia to Duala and Lome (the chief ports of Germany's two West African colonies). In 1924 a cable from Emden to London linked Germany with the Eastern Telegraph Company's cable system to South America. In 1927 a cable was completed from Emden to Horta (Azores) where it was connected with a cable to New York.

The expansion of the commercial importance of Emden was reflected in a growth of population from 14,800 in 1900 to 31,729 in 1925 and 34,200 in 1938.

Trade

As a port of any consequence Emden has grown up within the last half-century and was designed to serve a specific purpose, namely, the diversion to a German port of as much as possible of the enormous trade of the Ruhr, more especially of two chief components of that trade—the export of coal and the import of ores. It fulfils this function with some success, although the bulk of the trade still passes through Rotterdam. For general cargo and for the products of distant countries, however, Emden is of little importance.

Trade, 1937, *in thousands of tons*

Coastwise trade	*Inward*	*Outward*
East Prussia	25	102
Stettin	20	934
Lübeck	—	363
Schleswig-Holstein (Baltic)	—	170
Hamburg	53	571
Other North Sea ports, (excluding Bremen and Oldenburg)	8	416
	136	2,576
of which coal	—	2,187
coke	—	70
Foreign trade	3,917	1,595
of which coal	44	1,267
coke	3	315
ores	3,715	3
All trade	4,053	4,171

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, pp. 18–27.

The trade of Emden is simply described, consisting of three main components. The heaviest item is the import of foreign iron ores, the second greatest weight is provided by the coastwise export of coal and coke, and the third by the export of coal and coke to foreign countries. These three items amount for 7,549,000 tons out of the total trade of 8,224,000 tons. There is little import of timber and little export of semi-crude or manufactured iron and steel. Tropical products and general cargoes are hardly represented at all. The greater part of the import of ores is derived from Norway and Sweden (2,935,000 tons), with 294,000 tons from Spain, 244,000 tons from Canada, and 153,000 from North Africa. The leading foreign destination for coal exports was Spain (344,000 tons), followed by Egypt (123,000 tons) and Italy (162,000 tons).

It should be noted that the coastwise traffic plays a considerable part in the trade of Emden. The most recent waterway developments in Germany have tended to reduce its significance, however, for an

increasing quantity of coal from the Ruhr, which formerly reached Berlin by way of the Dortmund-Ems C., Emden, Hamburg and the middle Elbe, is now passing direct by way of the upper Dortmund-Ems and Mittelland canals.

Waterway Traffic. The dominant part in the trade of the port is played by the Dortmund-Ems C., which permits it to benefit from its geographical position as the nearest German port to the Ruhr coalfield. It has, therefore, a very specialized function. Although Emden has taken from Rotterdam, and to a lesser extent from Antwerp, much of the bulk trade for the Ruhr, exports of practically all the Ruhr products except coal and coke continue to pass by way of Rotterdam, Antwerp, Bremen and Hamburg, because from these ports liner services provide frequent sailings to all parts of the world.*

The importance of the canal connexion is shown by the fact that in 1937 the port handled 5,622,000 tons of canal-borne freight. The inward movement of cargo was almost equal to the outward:

Waterway traffic: 1937 (*thousands of tons*)

	Inwards	Outwards
Total	2,855	2,767
Ores	4	2,552
Coal and lignite	2,531	26

From: *Die Binnenschiffahrt im Jahre 1937*, pp. 6–7 (Berlin, 1938).

Stone, earth and sand made up most of the remaining inward waterway cargo, and timber and cereals most of the remaining outward cargo.

In the same year on the Rhine at Emmerich the downstream movement of coal amounted to 23,758,000 tons: a good deal of this was destined for export through Rotterdam, although much of the tonnage represented exports to the Netherlands, Belgium and France which would not have passed through Emden in any event. The upstream movement of ore, however, at the frontier—13,139,000 tons, was almost entirely an import for the Ruhr which had come via Rotterdam, Amsterdam, Antwerp and Ghent; its magnitude demonstrates clearly enough that the Rhine is still the dominant channel for the bulk trade of the Ruhr.

Railway Traffic. In spite of the Dortmund-Ems C., however, the railway plays an important part in the trade of Emden. Coal and ores

* For a discussion of liner traffic see Appendix IV.

dominate the traffic; coal movements inwards to Emden exceed ore movements outwards to the smelting centres.

Rail traffic at Emshäfen (Ems ports), 1937 (in thousands of tons)

	Inwards			Outwards	
	Coal	Coke	Total	Ores	Total
Oldenburg	—	—	54	111	177
Ruhr	1,349	349	1,832	673	732
Saar	—	—	—	233	236
Total (including unnamed districts)	1,349	349	1,975	1,017	1,219

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937*, Heft I, pp. 31, 35; Heft II, pp. 34, 37 (Berlin, 1938).

Emshäfen is traffic district no. 10 of the German railway freight returns (see p. 280); it includes a few small harbours such as Leer.

Industries

Beyond shipbuilding and repairing (see pp. 9–10), there is little industry carried on at Emden. The *Nordseewerke* constructs steam engines, boilers and auxiliary machinery. A certain amount of fish-canning and packing is carried on.

Communications

Rail. The basins of the port are well served by sidings, but connexions to the main line are not good: on the west side of the port, for example, there is only a single track. The railway leads to Norden: the line is single-track, except for a short section out of Emden. A marshalling yard and sidings lie on the north side of the Railway Dock near Emden Süd station. A light railway (metre gauge) runs to Pewsum, 7 miles to the north-west, and to Greetsiel.

Waterways. The Dortmund-Ems C. provides the principal communication link for the port, allowing 1,200 ton barges to reach Datteln, and thence Dortmund, the Ruhr and the Rhine; improvements which had been started in 1939 will allow the passage of 1,500- or 1,600-ton craft. Across the Ems estuary the Dutch port of Delfzijl admits to the waterways of the northern part of the Netherlands.

Roads. See Fig. 17.

WILHELMSHAVEN (Figs. 1, 7; Plates 2, 3)

53° 31′ N., 8° 10′ E. Population: 118,000 (1939)

Wilhelmshaven is situated 24 miles up the Jade River on the wide inlet of Jade Busen. Though of no significance as a commercial port, it is a principal base of the German navy. It is equipped to serve as a regular base for capital ships as well as for the North Sea U-boat fleet. There are extensive repair and building facilities.

Approach and Access

Wilhelmshaven is approached from the North Sea by the winding channel of the Jade River and Alte Jade. Depths are liable to change owing to shifting sands, and local knowledge is usually essential in approaching the port. In 1932, depths of 30 ft. could be carried through to Wilhelmshaven.

The two regular anchorages are Schillig Road and Wilhelmshaven Road, which provide large areas for anchoring. The tidal rise at H.W.S. is 13 ft., and 11½ ft. at neaps.

Detailed Description

There are four small tidal basins opening off from Jade Busen, and outside the wet-dock system, with charted depths of about 10 ft. Apart from these tidal basins the port consists of an extensive series of basins forming one large wet-dock, entered from tidal water by means of two lock entrances. A third entrance is under construction.

The dimensions of the locks are as follows (in ft.):

	Size of lock			Size of ship admitted		
	Length	Breadth	Depth	Length	Beam	Draught
Entrance I	454¾	78½	27*	424	72	
Entrance III						
North Lock	853	131	36	820	124	33
South Lock	853	115	36	820	110	33

* On sill at M.H.W.S.

Entrance III is the main entry for naval vessels. Entrance II has been out of use for some time past.

The port provides the following berthing accommodation:

Fig. 7. Wilhelmshaven

Based on official sources.

Ausrs.Hn. Ausrüstungshafen; Bau-Hn Bauhafen; F Ferry; Fd Floating dock; D.Br., H.Br., J.Br. Deich, Hafenthor, Jachmann Bridges; TPB Torpedoboots; V-Hn. Vorhafen; 1–3, 5–9 Plate, boiler, engine shops, etc.; 4, 16 Power stations; 10, 17 Gasworks; 11 School; 12 Town Hall; 13 Naval observatory; 14 Naval H.Q.; 15 Customs. *Deutsche Werke A.G. = Uto Werft.*

Fig. 8. Nordenham

Based on G.S.G.S. Series 4414, 1 : 25,000, Sheets 2416, 2417, 2516, 2517.

M.U. *Metallwerke Unterweser* (lead, zinc, etc., smelting plant); P. Pier; P.S. Petroleum berths and storage; Sh. Shipyard; S.F. Superphosphate works; S.K.F. Cable works.

Average length ft.	Minimum depth ft.	No. of berths	
		Total	Probably suitable for discharging
600	30	22	17
450	26	7	5
450	20	8	7
350	20	3	2
250	16	44	20
200	12	23	23

Inside the lock entrances Wilhelmshaven may be regarded as comprising four groups of basins. To the north of Entrance III (the larger entrance) is the extensive basin of the new harbour, still in course of construction, and to be approached by two very large locks. Running westwards from Entrance III are three basins forming the older part of the naval base—Ausrüstungshafen, Hafen Kanal, and the large square Bauhafen. Running south-westwards and westwards is the string of four basins forming the newer part of the naval port—Torpedoboots Hafen, Hipper Hafen, Scheer Hafen, and Tirpitz Hafen. Parallel with these is a line of canal basins leading to the Ems-Jade C. The dimensions of these basins may be summarized as follows (dimensions in ft.):

Older Basins	Length	Width	Depth	Length of quayage
Ausrüstungshafen	2,850	550	33	3,120
Hafen Kanal	1,020	215	33	1,300
Bauhafen	1,230	1,080	33	3,090
Newer Basins				
Torpedoboots Hafen	2,160	480	$26\frac{1}{4}$–33	2,430 (+ 3,410 jetties, etc.)
Hipper Hafen	4,265	1,640 average	15 –33	2,460 (+ jetties, etc.)
Seydlitzbrücke				3,280
Scheer Hafen	4,429	1,640 average	33 –36	2,000 (+ jetties)
Tirpitz Hafen	4,330	1,476 average	29	2,000 (+ jetties)

Along the north quay of Ausrüstungshafen is what is usually called the Dockyard. Bauhafen is the chief centre of naval shipbuilding and dry docks in the port. In the remaining basins a variety of naval installations are to be found, chief of which are the torpedo-boat berths along the south side of Torpedoboots Hafen; the destroyer base along the north side of Hipper Hafen (Gazelle Wharf); the submarine harbour and 40,000-ton floating dock along the north side of Scheer Hafen; and the *Deutsche Werke A.G.* (' *Uto* ') repair yard and floating docks along the north side of Tirpitz Hafen. In general, the south shores of the three big basins are not fully developed. A seaplane

station occupies the eastern end of the south side of Hipper Hafen. There are oil installations on the south sides of the three basins.

Hipper, Scheer and Tirpitz Hafens are large enough for ships to move under their own power, tugs being necessary only for berthing. In Tirpitz and Scheer Hafens, also, ships may swing to check compasses.

Entrances within the Port. Between Tirpitz and Scheer Hafen there is a 600-ft. passage, and between Scheer and Hipper Hafen there is a 300-ft. passage; both of these are crossed by ferries. Passages connecting other basins are narrower and are crossed by bridges (Fig. 7).

Bridge	Passage crossed	Type	Clearance, in ft.
			Width
Kaiser Wilhelm	Entrance to Hipper Hfn.	Turning ; Road	230
Jachmann*	Hafen Kanal	Turning; Road	160
Pontoon*	Hafen Kanal	Pontoon; Road	
Hafenthor*	Durchfahrt	Caisson; Road, Rail	200
Old Insel*	—	Turning; Road, Rail	75
Deich*	Entrance to Ems-Jade C.	Turning; Road, Rail	
Rüstringen	Ems-Jade C.	Turning; Road	

* Information approximate as to type.

The Canal Basins. Westwards from the Deich bridge there are four basins for canal traffic, consisting of widened portions of the canal. Handels Hafen, on the north bank, is very narrow; Strombau, Kanal Kohlen and Kanal Häfen, on the south bank, are much wider. Kanal Kohlen Hafen is a coaling basin, equipped with two large transporters, and with 2,250 ft. of quay. The length of quayage in the other basins is: Handels Hafen, 660 ft.; Strombau Hafen, 1,100 ft.; Kanal Hafen, 1,980 ft.

Port Facilities

Apart from specialised gear for naval purposes, there are few cranes in the port; they number about five, of small or medium capacity. For the building and repairing activities there are three pontoon floating cranes, of 250, 100, and 40 tons capacity; there are thought to be also five further light or medium floating cranes. In the Bauhafen there are six medium travelling tower cranes

connected with the dry docks, and seven or eight medium travelling tower cranes which work along the building slips.

The *Marine Werft* or dockyard, on the north-west and south sides of the Bauhafen, is the only site in the port at which ships are built; these yards form the principal dockyard of the German navy. Warships of all types can be built, repaired and maintained; large vessels constructed here include the *Graf Spee* (10,000 tons displacement), *Admiral Scheer* (10,000 tons), *Tirpitz* (est. 45–53,000 tons), and *Scharnhorst*. Merchant vessels were also built in this yard.

There are two building slips, partly covered: one is reported to be 700 ft. long, and the other was lengthened to over 793 ft., for the construction of the *Tirpitz*. There is an extensive range of buildings in the yard, of all types necessary for the construction and maintenance of a large fleet. There are six dry docks—one of 381 ft. overall length, two of 432 ft., and three of 631 ft. There is also a 40,000-ton floating dock normally moored in Scheer Hafen.

The other extensive installation is that of the *Deutsche Werke Rüstringen A.G.*, on the north side of Tirpitz Hafen. This establishment was taken over by the navy in 1937, and now seems to be known as *Uto Werft—U-boots und Torpedowerft*. The site of 250,000 square yards is mostly covered by shops, the exact function of which is not known. There are no building facilities, and the yard is devoted entirely to the repair and maintenance of light surface vessels and submarines.

Two smaller repair yards have been dismantled.

The Town

Wilhelmshaven is situated only 5 ft. above mean sea level, in the flat country along the north-west shore of the Jade Busen. Both town and port serve naval requirements. Commercial activity—in the commercial docks at the eastern end of the Ems-Jade C.—and the occupation of catering for the needs of summer visitors to the seaside are of minor importance.

The town and its naval dockyards and shipbuilding yards are entirely creations of the nineteenth century. The town was built between 1855 and 1869 on polder land protected by dykes against floods. The town has fine broad straight streets and many open spaces. The main thoroughfare, the Roonstrasse, runs east and west through the market square. Buildings of note are the *Elisabethkirche* (Gothic style), the Protestant *Christuskirche*, the Catholic *Willihadkirche*, the Town Hall (1891–2) and the *Kaiser Friederich Kunsthalle*

(1913). To the original *Marinewerft*—an inner and an outer basin—a new harbour was added in 1886. An additional entrance to the new harbour was built later. Further docks, capable of holding large battleships, were completed in 1906.

The site upon which Wilhelmshaven was built—4 sq. miles in area—was purchased by Prussia from Oldenburg (1853) and after the annexation of Hanover (1866) the Wilhelmshaven district was administered as part of the *Regierungsbezirk* Aurich of the Province of Hanover. On April 1st, 1937, Wilhelmshaven was incorporated again in the Federal State of Oldenburg. It has the status of a municipal borough (*Stadtkreis*). At the same time the good-class residential suburb of Rüstringen was added to Wilhelmshaven. The chief architectural feature of Rüstringen is its modern Town Hall.

Wilhelmshaven is an administrative centre in the Reich for finance (*Finanzamt*), customs (*Zollamt*), banking (*Reichsbankstelle*), public works (*Reichsbauamt*) and naval affairs (*Marinoberkommando Nordsee, Marine Sternwarte*, etc.). There are scientific research institutes for investigating the climate of the North Sea and also the *Watten* of the North Sea coast. Educational institutions include several secondary schools and (at Rüstringen) a Trades School.

The town and port have been severely damaged by air attack and will require much rebuilding.

History

Before 1853 the tiny Prussian navy was administered by the Prussian War Office. In that year a Prussian Admiralty was established and Prince Albrecht was appointed to take charge of it. One of its first actions was to establish a naval base in the North Sea. A site on the Jade Busen was chosen and in 1854 the necessary land was bought from Oldenburg. Here naval docks and a new town were built between 1855 and 1869. Important extensions were made in 1886 and in 1906. The construction of the Ems-Jade C. in 1880–7 linked Wilhelmshaven with Emden by an inland waterway 44 miles in length.

The port traffic increased and in 1914 cargoes of over 500,000 tons were handled. The population rose from 20,000 in 1885 to 26,000 (including 8,227 in the service of the army and navy) in 1905 and to no less than 45,000 in 1916. After the war of 1914–1918, when Germany had only a small navy, the population fell and amounted to only 25,484 in 1925. Since Wilhelmshaven's industries—the

machine shops, the boiler works and the iron foundries—were almost entirely dependent upon orders from the naval dockyard there was slack trade and unemployment. For a year or two the naval dockyard built merchant ships—four vessels of 5,700 tons each being launched in 1922–3. Efforts were made to develop the commerce of the port—the export of local farm produce and the import of coal and timber—and also to attract visitors in the summer months. When the Nazis came into power the construction of a new navy kept the dockyards busy. The population increased again, and in 1933 the town had 27,861 inhabitants, while in 1938 Wilhelmshaven and the recently incorporated suburb of Rüstringen had a population of 87,700 and of 118,000 a year later.

Trade

The trade of Wilhelmshaven is confined mainly to import traffic.

Trade, 1936, 1937 (*thousands of tons*)

Total		Coastwise		Foreign	
		Outwards	Inwards	Outwards	Inwards
1936	261·7	8·4	164·5	0·9	87·9
1937	421·5	11·2	141·9	4·6	263·8

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

The port has no commercial hinterland to speak of, and its trade arises mainly from the import, both coastwise and foreign, of coal, liquid fuels and raw materials.

Industry

The naval base provides the only industry of Wilhelmshaven (see p. 18), and the town is not big enough to support any consumer industry.

Communications

Rail. All quays in the port at which cargo could be discharged have adequate rail connexions. From the quays the tracks converge to pass westwards either through Wilhelmshaven main station, or by way of a by-pass line along the north side of Strombau and Kanal Kohlen Häfen to reach the railway at Rüstringen station. The tracks in the southern part of the harbour reach the main line farther west beyond the limit of the basins. Facilities for sorting goods

wagons are very limited. The railway (double-track) connects the port with Oldenburg and Bremen; the nearest large marshalling yard is situated at Oldenburg, 32 miles distant, with a capacity of up to 2,000 wagons in 24 hours.

Waterway. The Ems-Jade C. provides waterway connexion for 200-ton barges to Emden, and thence with the Dortmund-Ems C.

Roads. See Fig. 17.

Bremerhaven (Fig. 9; Plates 4, 5)

53° 33′ N., 8° 34′ E. Population: 114,000 (1941)

A number of ports are situated on the great estuary of the Weser—the large ports of Bremerhaven–Wesermünde and Bremen, and the secondary ports of Blexen, Nordenham, Brake, Blumenthal and Vegesack. Bremerhaven lies nearest the sea, being 32 miles distant from open water. It is distinct from Bremen in harbour facilities, but economically the two are interdependent, and it is often regarded as an outport of Bremen, although its functions transcend those of an outport like Tilbury.

Approach and Access

Bremerhaven lies on the right or east bank of the Weser, at a point where the wide estuary, partly taken up by the extensive flat of Hohe Lütjen Sand, narrows rapidly to a width of less than a mile. At this point the deep channel comes close to the east bank. The channel from the sea is narrow and liable to change locally. Though well buoyed in peace-time, pilots were always employed.

Weather conditions do not normally interfere with the working of the port. Strong and sustained easterly winds may cause the level in the river to fall 3 or 4 ft. below charted depths, seriously hindering port traffic, but such occasions are very infrequent.

	Bremerhaven	Bremen
M.H.W.S.	12·2 ft.	10·8
M.L.W.S.	– 0·2 ft.	– 0·4
Mean level	6·0 ft.	5·2

During hard winters, if there are sustained temperatures below 25° F., drift ice becomes a serious obstacle to smaller coastwise ships. In such conditions, the channel, in normal times, is kept open by icebreakers. Large vessels, with the assistance of tugs, however, can use the river without interruption.

Anchorages. Anchorage for large vessels may be found in the entrance to the Weser estuary, about 22 miles below Bremerhaven, inside the Roter Sand lighthouse, where least depths of 42 ft. exist. Farther up the river only small coasters may anchor, on the edge of the fairway, as far as Bremerhaven, but beyond as far as Bremen no anchoring is possible.

Detailed Description

Bremerhaven is continuous with the smaller port of Wesermünde, and in the following account the two are described together. The entire port is of considerable extent, and provides the following accommodation:

Berths available

Maximum length, ft.	Maximum depth, ft.	No. of berths
600	30	21
450	26	13
450	20	33
350	20	12
250	16	1
200	12	2

In addition there is considerable berthing accommodation for small vessels such as coasters. The largest vessel using the port in normal times was the *Bremen*, 51,731 tons gross, 898 ft. long, 102 ft. beam, about 36 ft. draught.

A prominent feature of the port is the Columbus Quay along the Weser, where dredging had achieved a least depth of 39 ft. in order to accommodate the *Bremen* and *Europa*. The main quay provides a berthing length of 2,500 ft., and is equipped with rail and crane facilities for the rapid handling of passengers and light cargo.

The port of Bremerhaven lies to the north of the mouth of the river Geeste, and the port of Wesermünde lies to the south. Of the docks of Bremerhaven, Alter Hafen, the most southerly, formerly connected with the Geeste river by a lock (Old Lock), but this is now partly filled in. Three locks give admission to the basins of the port. The most northerly is the North Lock (Nord Schleuse), which has a least depth in the approach of 42½ ft., and a similar sill depth; it is 147 ft. wide in the gates and has a length of 1,216 ft. between the gates, which are of the rolling type. The central lock is the Grosse Kaiser Schleuse, 1,732 ft. long and 97 ft. wide. It is normally operated at high water, when the sill depths are 24 ft. at H.W.N. and 35 ft. at H.W.S. The outer gates are double-mitre gates, while

at the inner end there is a rolling gate. The third lock is the New Lock, which is not properly a lock, but one set of double-mitre gates spanned by a lifting road bridge, giving an entrance 72 ft. wide and 23–28 ft. deep over the sill. It is probably not now in use.

Details of the basins may be summarized as follows:

	Minimum depth, ft.	Approx. length quayage, ft.	No. of quay cranes
Turning Basin	39	None	None
Connecting Dock	33*	4,100	3
Approach to Kaiser Dok II	33	1,450	2
Kaiser Hafen III	33†	4,600	15
Kaiser Hafen II	33†	3,710	23
Kaiser Hafen I	26†	5,570	4
Neuer Hafen I	29	6,190	5
Alter Hafen	23	4,190	3

* Depth normally maintained at 38 ft.
† Additional 5 ft. normally maintained.

The Turning Basin serves to provide access from the North Lock to the Connecting Dock (Verbindungs Hafen), which is entered by a passage about 130 ft. wide crossed by a swing bridge carrying a single rail track. Northwards of the Turning Basin work on an extension has been started. The west side of the Connecting Dock is quayed and well equipped; on the east side are the two *Norddeutscher Lloyd* dry docks, Kaiser Dok I and Kaiser Dok II. At the south end of the Connecting Dock an entrance about 190 ft. wide gives access to the Kaiser Hafen I, II, III. These three basins, which are also entered by the Grosse Kaiser Schleuse, form the principal section of the port of Bremerhaven, and are well equipped with shore installations. The west quay of Kaiser Hafen III was largely used for the banana trade. Neuer Hafen, second in importance, is equally well equipped. While entered directly from the Weser, by the New Lock, it is also reached from Kaiser Hafen I by a passage 70 ft. wide closed by two pairs of single-mitre gates. Southwards a passage leads into Alter Hafen. On the west side of Neuer Hafen there is a dry dock, normally used by Iceland trawlers and small craft.

Wesermünde. The port of Wesermünde is smaller, being concerned mainly with the fishing fleet. It is entered by a double lock, with roller gates. The lock is 328 ft. long and has depths over both sills of $21\frac{1}{2}$ ft. at M.L.W. and $32\frac{1}{2}$ ft. at M.H.W. The west section of the lock is $39\frac{1}{2}$ ft. wide and the east section of the lock is 98 ft. wide.

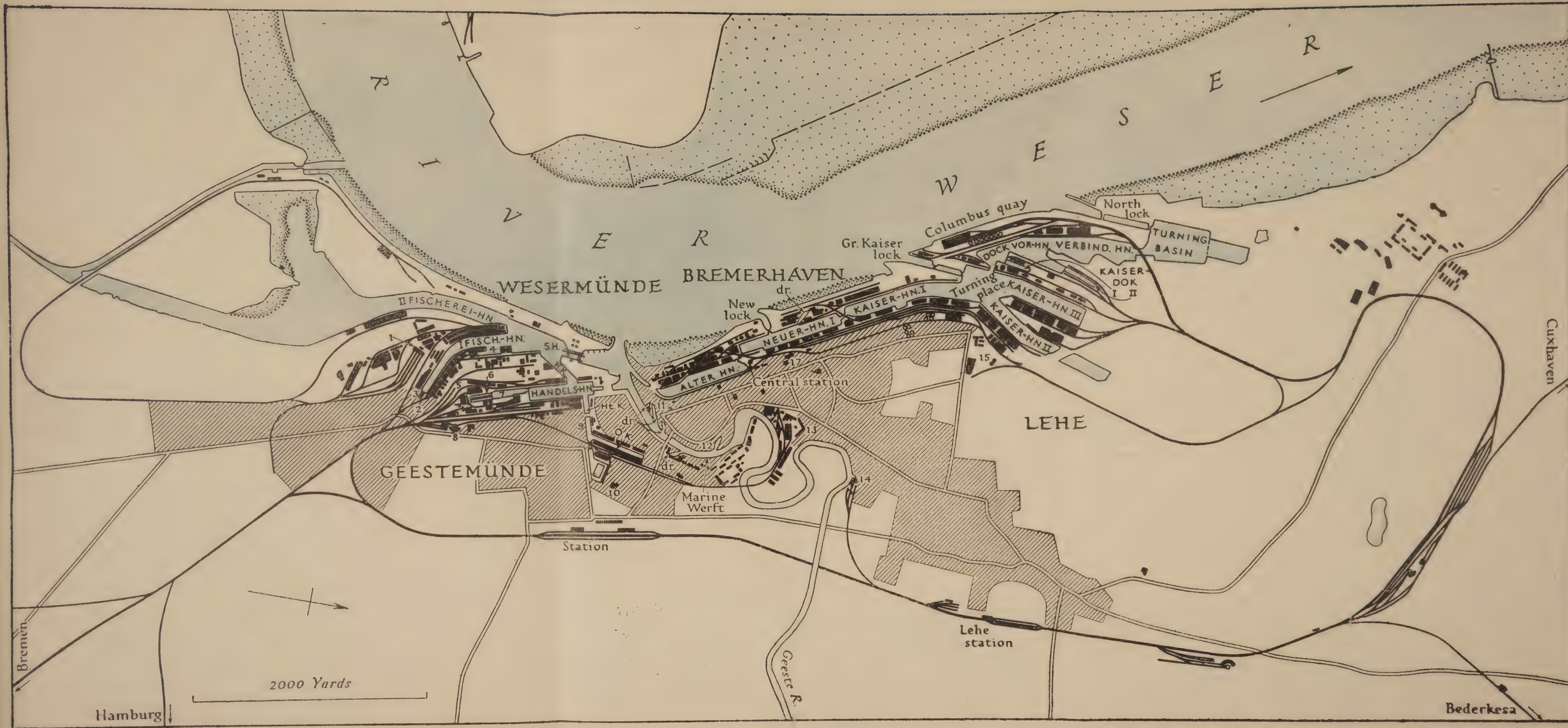

Fig. 9. Bremerhaven-Wesermünde

Based on official sources.

dr. Dry dock; H.K. Hafen Kanal; Ht.K Haupt Kanal; O.K. Ouer Kanal; S.H. Schleusen Hafen; 1 Fischerei Hafen station; 2 *Deschimag Tecklenborg* shipyard; 3 Patent slips; 4 *Schiffsbau Ges. Unterweser* (with small slips); 5 *Deschimag G. Seebeck* shipyard; 6 Baudock I, II; 7 Ausrüstungs Hafen; 8 Loco. shed; 9 Post Office; 10 (Probable) transformer station; 11 *G. Seebeck A.G.*; 12 Site of former dock; 13 *Norddeutsche Werft* (*Rickmers*) shipyard; 14 *Unterweser Werft* shipyard; 15 Gasworks; 17 Port power station.

The port comprises four main basins, details of which may be summarized as follows:

	Depth, ft.	Approx. total length of quay, ft.
Schleusen Hafen	23	1,550
Fischerei Hafen II	Mainly shallow	—
South Quay	23	1,260
Fischerei Hafen I	23	4,300
Handels Hafen	23	2,950
Ausrüstungs Hafen	23	—

Fischerei Hafen II is bounded mainly by rough banks. Fischerei Hafen I is the centre of the fishing activities of the port; the quays are served by warehouses and rail tracks. At the head of the basin there are patent slips for the repair of trawlers and small craft; on the east side, within a branch basin, there are building slips for the construction of small craft. On the north side of the port, approached from the Fischerei Hafen by Hafen Kanal, is Handels Hafen, which was frequented by most of the restricted amount of merchant shipping using Wesermünde. The quays are served by warehouses and rail tracks. At the south end of Handels Hafen are the fitting-out basin (Ausrüstungs Hafen), small slip, and two construction dry docks of the *Deschimag* Tecklenborg* shipyard. From the north end of Handels Hafen a long and narrow cut branches off, known as Haupt Kanal and Ouer Kanal. These two channels are quayed on both sides and in peacetime were used by light naval craft.

Port Facilities

The warehouse accommodation in Bremerhaven and Wesermünde is extensive, and covers altogether about 57 acres. There are 27 warehouses and large sheds which seem to serve the function of warehouses in Bremerhaven and 18 in Wesermünde, excluding small sheds. Stacking space is now comparatively good, as bombed warehouse areas adjacent to the Kaiser Hafen and Alter and Neuer Häfen are quite well cleared.

In addition to the quay cranes mentioned above, there is a fixed electric 125-ton crane on the east side of the approach to Kaiser Dok II, off the Connecting Dock.

The repair facilities are considerable. There are two 800-ton floating docks, one in Handels Hafen and one in Fischerei Hafen II. The dry docks and slips are as follows (dimensions in ft.):

The Kaiser Dok II was used for docking the *Bremen* and *Europa*;

* *Deutsche Schiff- und Maschinenbau A.G.*

	Length	Width of caisson	Remarks
Bremerhaven:			
Dry Docks			
Kaiser Dok I	754	98	
Kaiser Dok II	1,099	132	
Neuer Hafen	440	55	
Wesermünde:			
Dry Docks			
Ausrüstungs Hafen	522	85	Deschimag Seebeck yard: two similar docks used for ship-building with two travelling gantry cranes.
Slips			
Fischerei Hafen I:			
Tecklenborg yard, 3 patent slips	150		
Unterwester yard, 2 slips	200		
	185		
Ausrüstungs Hafen 2 slips	240		Deschimag Seebeck yard: 2 travelling gantry cranes.
	215		
Geeste River:			
Dry Docks			
Deschimag Seebeck yards, 4 docks:			
South Bank No. 3	350	42	
North Bank No. 3	280	47	
No. 4	520	57	Apparently out of use.
No. 5	140	45	
Slips		%	
Norddeutsche A.G.:			
2 patient slips	460		
	300		
1 patient slip	160*		
2 broadside slips	220		
	220		
Unterweser:			
1 slip	165		
2 broadside slips	195		
	215		

* Above water line.

to accommodate these ships it was necessary to raise the water level to the top of springs, and as a result office buildings were sometimes flooded.

The port of Bremerhaven-Wesermünde as a whole is more important for ship-repairing than for shipbuilding, although five yards have engaged in construction. The *Deschimag* company has

two building yards in Wesermünde—the Tecklenborg yard at the south-east end of Fischerei Hafen I and the G. Seebeck yard at the south end of Ausrüstungs Hafen. The Tecklenborg yards now build only small ships; the G. Seebeck yard has built vessels up to 8,000 tons—it has two slips 240 ft. and 215 ft. long (see p. 26). The *Unterweser* yard, with two slips in the east side of Fischerei Hafen I, builds small ships. The *Unterweser Werft* yard on the Geeste river has built ships up to 1,100 tons, but normally builds vessels of 200–400 tons. The *Norddeutsche Werft G.m.b.H.* (formerly *Rickmers*) yard, lower down the Geeste, is the largest and most active yard in Bremerhaven-Wesermünde.

The Town ; History

See pp. 35–6. Bremerhaven has been severely damaged by air attack and will require much rebuilding.

Trade and Industries

Details of trade for the port are not published separately. The total cargo movement was as follows:

Trade, 1936, 1937 (*in thousands of tons*)

	Total	Coastwise		Foreign	
		Outwards	Inwards	Outwards	Inwards
Bremerhaven					
1936	555·2	26·9	29·3	66·5	432·5
1937	622·6	17·9	35·3	64·3	505·1
Wesermünde					
1936	49·2	8·5	11·8	0·8	28·1
1937	45·3	6·3	8·0	0·7	30·3
Total					
1936	604·4	35·4	41·1	67·3	440·6
1937	667·9	24·2	43·0	65·0	535·4

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

Industries are of little importance beyond the considerable shipbuilding and ship-repairing activity (see p. 26).

Blexen, Nordenham, Brake, Blumenthal, Vegesack

Along the Weser estuary between Bremerhaven and Bremen there are a number of smaller ports, four of which carry on considerable, though specialised, activity—Nordenham, Brake, Blumenthal, Vegesack. These ports derive their trade mainly from the existence of nearby factories which benefit from cheap water transport, both by sea and by river.

Blexen (Fig. 8)

At Blexen there is 200 ft. of quayage, with $33\frac{1}{2}$ ft. depth at M.L.W.S., mainly for the use of tankers serving the oil storage. There is also a tidal basin, 280 ft. long and $88\frac{1}{2}$ ft. wide, with depths of from 5 to 8 ft.

Nordenham (Fig. 8)

Nordenham (20,000) lies a short distance above Bremerhaven-Wesermünde, on the opposite (left or west) bank of the estuary. It faces south-east and is therefore fully protected from the prevailing westerly winds. The port is accessible to very large ships, having 3,600 ft. of quayage with 38 ft. depth at high water and 30 ft. at low water; this quayage is equipped with 12 cranes up to 20 tons. Of this length of quayage, 650 ft. is operated by the *Metallwerke Unterweser A.G.* Most of this quayage is provided by offset piers, connected to the shore by structures at right angles. There is a 5-ton floating crane. The fishing activities of the port are served by the Fischereihafen, with 15 ft. depth at low water and 1,312 ft. of quayage.

The quays have railway connexion. The Reichsbahn system, however, is reached only by one single-track line, which runs southwards through Elsfleth to join the Wilhelmshaven-Bremen double-track at Hude.

Trade. The trade handled by Nordenham is considerable, and in fact makes it much more than a minor port.

Trade, 1936, 1937 (*in thousands of tons*)

	Total	Coastwise		Foreign	
		Outwards	Inwards	Outwards	Inwards
1936	1,161·5	198·4	32·8	800·0	130·3
1937	1,212·5	133·1	44·7	937·0	97·7

From: *Die Seeschiffahrt im Jahre 1937* Heft I, p. 4.

No detailed analysis of trade items is available. Exports comprise coal, coke and manufactures, and imports coal and ore.

The work of the port is related largely to two considerable industrial plants. The *Metallwerke Unterweser A.G.* lead and zinc smelters had, in 1938, an annual capacity of 15,000 tons of lead. Ocean steamers discharge directly at the pier, where a travelling gantry has a capacity of 1,200 tons of ore or coal per 24 hours.

The plant uses Ruhr coal, and in 1935 had a consumption of 50,000 tons of coal and 7,000 tons of coke. Power is derived from the north-west Germany grid. Sulphuric acid is produced for the nearby *Superphosphat-Fabrik Nordenham A.G.*, which is one of the leading producers of superphosphates in Germany. There is also a submarine cable works (*Seekabel Fabrik*). A short distance to the north there is an aircraft factory at Einswarden.

Brake (Fig. 10)

This port lies on the west bank of the Weser a few miles above Nordenham. It is situated on the main (western) channel of the estuary, at a point where the river is divided by the long island of Harrier Sand. There is a pier parallel with the bank, 3,220 ft. long, to the north (downstream), and a short 'T'-shaped private pier 443 ft. long, farther downstream owned by the *Fett-Raffinerie A.G.*, both with 34 ft. of water at ordinary high tide. Both these piers carry railways, and the long pier is connected with the shore by two bridges, as well as by the root. Opening off the Weser is a harbour, with a wet-dock, 1,440 ft. long and 360 ft. wide, entered by a lock 43 ft. 5 in. wide, with a depth on the sill of $19\frac{1}{2}$ ft. at ordinary tides. The length of quayage in the dock is 2,624 ft.; a canal provides a further 750 ft. of quayage. Besides 10 electric cranes of $1\frac{1}{2}$–$2\frac{1}{2}$ tons, there are two bridge cranes of 3 tons, a 20-ton crane, a 5-ton electric whipping crane, and 6 grain elevators with capacities of 60–100 tons per hour. Modern grain silos and/or granaries provide storage capacity of 100,000 tons. There is a dry dock built specially for lighters, etc., with a bottom length of 227 ft. and an entrance breadth of 40 ft., and a depth on the sill of 13 ft. M.H.W.S. Both piers and the dock have rail connexions; two single-track lines run southwards to Bremen via Elsfleth and Hude, and to Wilhelmshaven.

Trade. The tonnage of cargo handled is considerable, and arises mainly from foreign trade.

Trade, 1936, 1937 (*in thousands of tons*)

	Total	Coastwise		Foreign	
		Outwards	Inwards	Outwards	Inwards
1936	318·1	21·0	69·2	124·2	103·7
1937	679·8	85·0	61·6	160·9	372·3

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

No detailed analysis of trade items is available. Exports comprise salt, kainit, coal, coke, grain and stone; imports comprise timber, coal, slate, pig-iron, manures, cement, stone, grain, ore and nitrate. The port is the site of an important oil mill, engaging in the hydrogenation of vegetable and marine oils, with an estimated capacity for treatment of 135,000 tons annually.

Blumenthal (Fig. 11)

Blumenthal lies on the right bank of the Weser, just below Vegesack, where the estuary takes up a north-west—south-east direction. There is a small and narrow tidal basin and a quay along the Weser. The quay carries sheds and is served by a line of railway; behind it lies a wool combing mill. The quay railway connects with the single-track line running north and south along the west shore of the Weser estuary between Vegesack and Bremerhaven.

Trade. Trade is very restricted, and in 1937 amounted only to 23,000 tons, mostly in the coastwise trade.

Blumenthal is the site of one of the largest wool-washing and combing mills in Germany, *Bremer Wollkämmerei*. There are two small shipbuilding yards in the Rönnebeck district nearby.

Vegesack (Fig. 11)

Vegesack (4,400) is a small port on the right bank of the Weser. The town is situated on the sandy bluff formed by the *geest*, at a point where the deep channel comes close to the right bank, and much of it is about 20 m. above sea level. Vegesack was formerly of some importance as an outport for Bremen, but its importance declined following the creation of Bremerhaven in 1827 and the regulation works in the estuary which, while improving depths at Bremen, reduced depths at Vegesack. There is a tidal basin, admitting ships up to 13 ft. draught, with 860 ft. quayage, and with a railway close behind and cranes, together with staithes for shipping coal. There was, in 1939, a steel floating dock, $98\frac{1}{2}$ ft. long, used for fishing vessels only.

Vegesack is now important mainly as a shipbuilding centre. The *Bremer Vulkan Schiffbau und Maschinen Fabrik* yard has six building slips, the longest of which is 650 ft. In peace-time the yard constructed mainly motor vessels: the largest built here was the *St. Louis*, 16,735 tons gross. Diesel-engines (M.A.N.) were constructed at the yard. Many of the ships built by this yard, however, were fitted with reciprocating engines and turbines. East of the slips

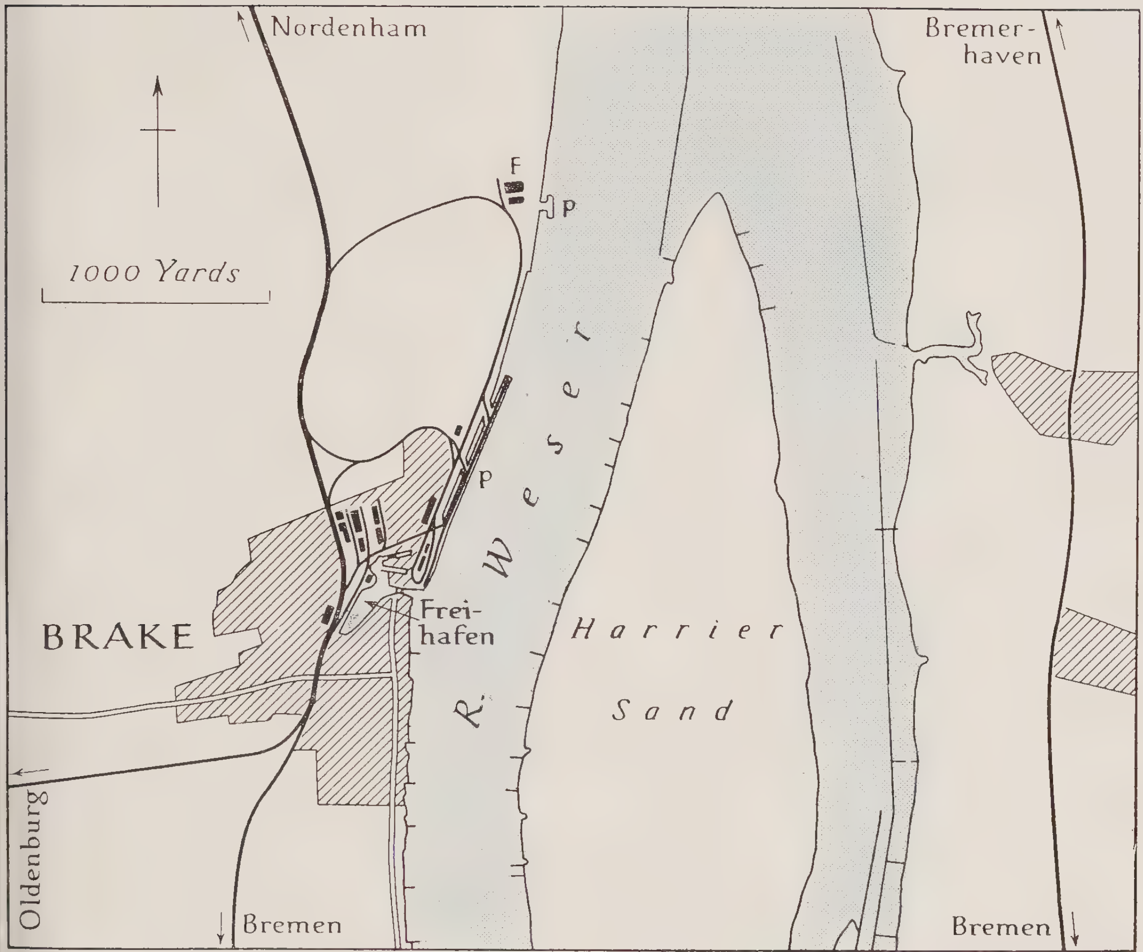

Fig. 10. Brake

Based on G.S.G.S. Series 4414, 1 : 25,000, Sheets 2616, 2617.

F Factory; P Pier.

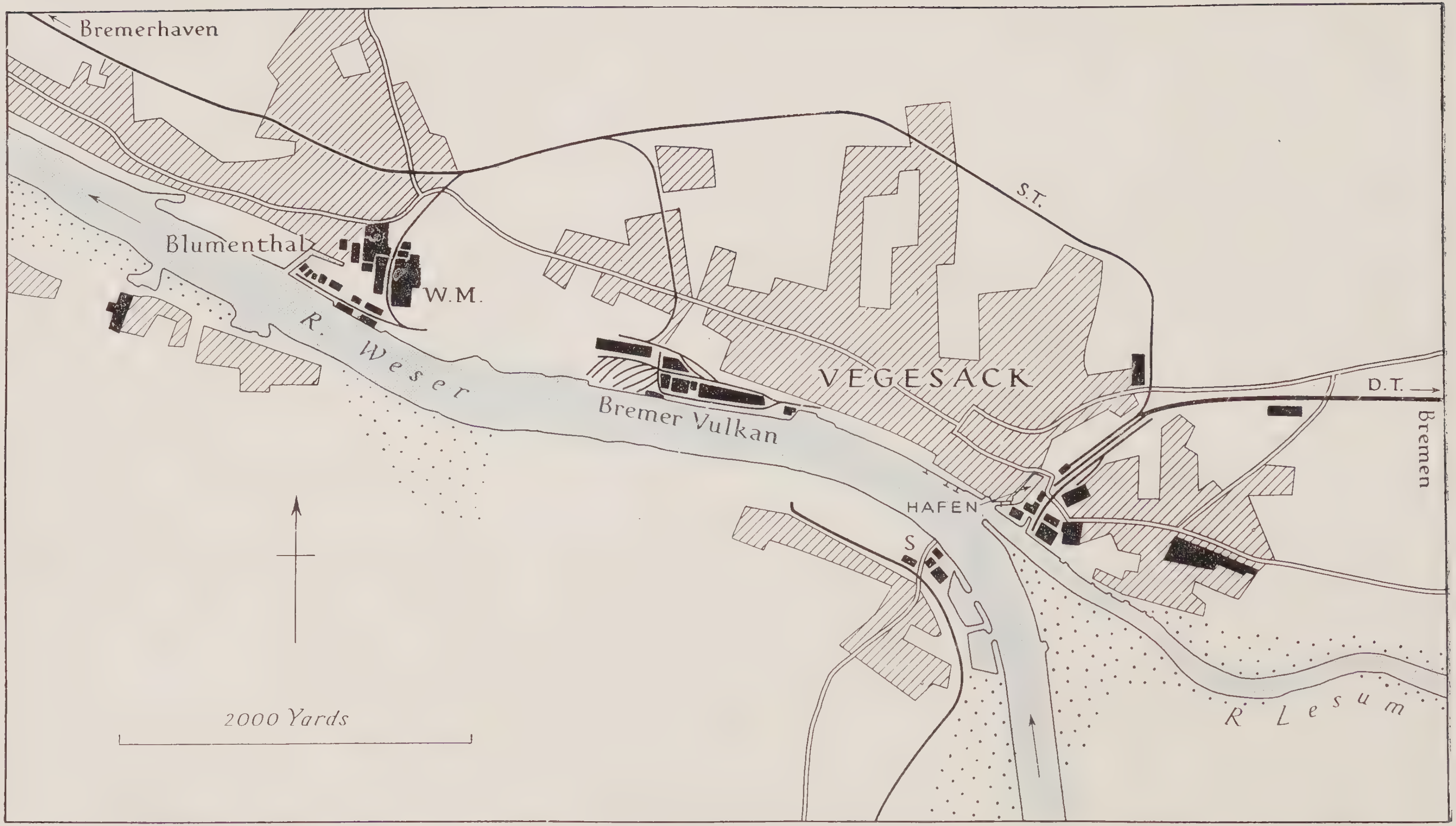

Fig. 11. Vegesack and Blumenthal

Based on G.S.G.S. Series 4414, 1 : 25,000, Sheets 2817, 2818.

D.T. Double-track; S.T. Single-track; S Small shipyard (a second small yard is situated on the left-bank inlet west of Blumenthal); W.M. *Bremer Wollkämmerei* (wool-combing works). The *Bremer Vulkan* shipyard represents the main industry of Vegesack.

is what appears to be a fitting-out quay having railway connexion. There is thought to be a small yard on the south-east side of the tidal basin. Other yards include the *Türsser* yard on the east bank of the Weser at the Lesum confluence, with a small slip, building sheds and a small floating dock. It builds motor torpedo boats, etc., in conjunction with *Abbruchs Werft* on the west bank of the Weser. South of this latter yard, on the west bank, is the *Afeking and Rasmussen* yard, with two slips and seven building sheds; it builds minesweepers, etc. A factory at Vegesack has a considerable manufacture of wall and floor tiles.

The shipyard tracks lead to a single-track line which connects behind the tidal basin with the double-track line leading to Bremen.

Bremen (Figs. 12–16; Plates 8–10)

53° 07′ N., 8° 45′ E. Population: 342,000 (1939)

Bremen is the second largest seaport in Germany, and an industrial centre of some importance, although it has not developed in this way to the same extent as Hamburg. It lies 35 miles up the Weser from the outport of Bremerhaven. Details of tides, weather, etc., are described on p. 22.

Detailed Description

The berthing accommodation of the port is very considerable:

Average length, ft.	Minimum depth, ft.	No. of berths
600	30	—
450	26	15
450	20	54
350	20	9
250	16	33
200	12	52

The port lies almost entirely on the right or north bank of the Weser, and comprises two distinct sections. The western or down-river section lies near the suburb of Oslebshäusen, a good distance west of the city, and is known as Industrie und Handels Hafen. This harbour is normally used for heavy cargoes, and is specially equipped to handle exports of coal and fertilizers, and imports of ores and timber. It is a large wet-dock with five branches. The eastern or city harbour consists of five tidal basins with two entrances from the Weser. The most important of these basins constitute the

Freihafen (Free Harbour). The tidal basins handle all the passenger trade, general cargo, grain and tropical produce.

Industrie und Handels Hafen. This harbour is entered through a lock facing west, with a single rolling type gate at each end. The lock is 561 ft. long, 82 ft. wide at the entrance, and has a sill depth of 22 ft. below chart datum. At high water, the normal time for operating the lock, a depth of 28–29 ft. is found. The depth maintained in the harbour is normally $24\frac{1}{2}$ ft. If the lock were open but inoperative, the harbour would become tidal with a least depth of about 14 ft.

The harbour consists of a long connecting channel, Hafen A, about 2,700 yards in length. From it branch northwards five basins known as Hafen B, C, D, E and F (from west to east); Hafens B, C and D are also known as Hütten Hafen, Kohlen Hafen, Kali Hafen. From the northern end of Hafen B (Hütten Hafen) a sixth basin branches off—Hafen G (Öl Hafen). A great part of the length of these basins is not quayed and consists of steeply sloping stone dykes. The basins may be described in tabular form as follows:

	Approx. dimensions, ft.		Approx. length of quayage, ft.	No. of quay cranes	No. of other cranes
	Length	Breadth			
Hafen A (Industrie und Handels Hafen)	8,100		1,500 (for waiting)		
			1,250 (Deschimag yard)	4	
Hafen B (Hütten Hafen)	3,450	300	3,410	2	8 E.B.C.
Hafen G (Öl Hafen)	2,225	180	610	2	
Hafen C (Kohlen Hafen)	2,400	330–210	2,830*	—	9 E.B.C.
Hafen D (Kali Hafen)	1,950	330	2,340	1	3 E.B.C. 4 M.T.
Hafen E	1,500	240	1,955†	3	1 E.B.C.
Hafen F	1,050	180	990		

E.B.C. Electric bridge crane; M.T. Mechanical transporter.

* Along dolphins.

† 725 ft. along a line of dolphins and 1,230 ft. of berthing along three sets each of four piers (timber berth).

Plate 1. Emden: Nesserland Lock, looking seawards (south)

In the foreground is the Binnenhafen, in the background the Aussenhafen, with lighters moored at a line of dolphins. Behind the Aussenhafen can be seen the Vorhafen, leading to the New Emden Lock on the left, which opens into the Neuer Binnenhafen.

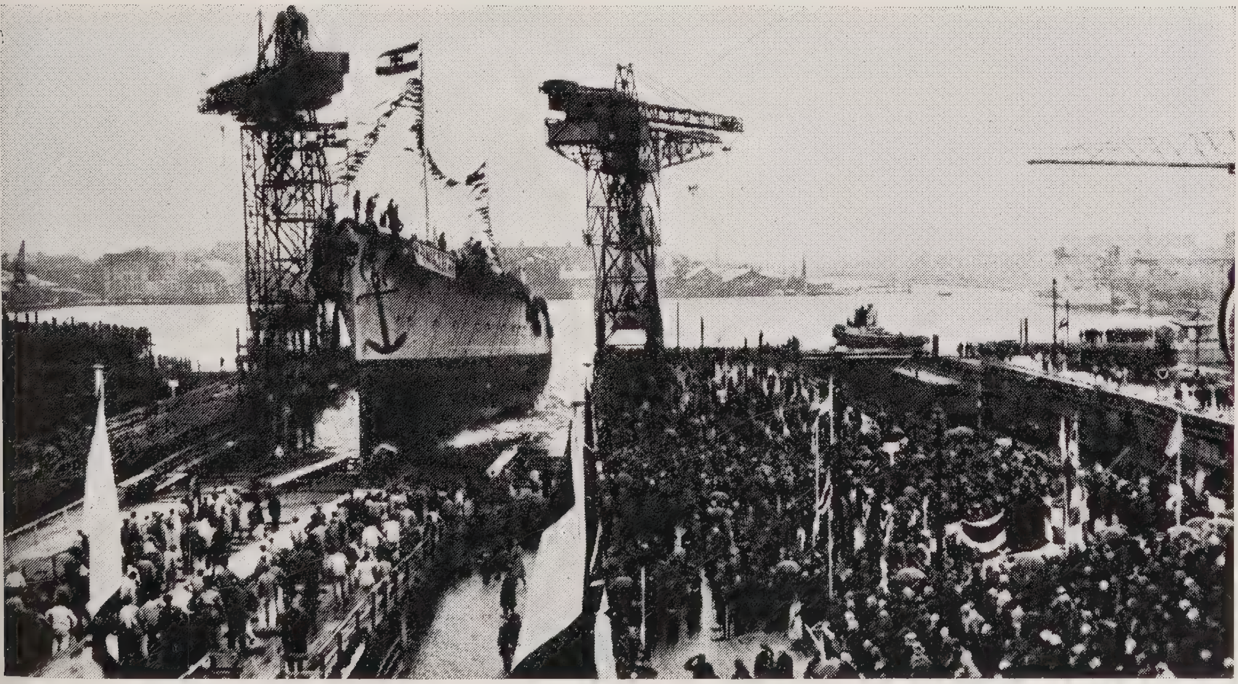

Plate 2. Wilhelmshaven: launch of the cruiser *Königsberg*

The launch is from a slip in the Bauhafen.

Plate 3. Wilhelmshaven: Kaiser Wilhelm Bridge
In the foreground is part of Scheer Hafen.

Plate 4. Bremerhaven: Columbus Quay, looking east
The liner alongside is the *Bremen*. In the background are Kaiser Häfen I and II.

Further berthing in these basins is provided by lines of dolphins, and for small craft, by a number of short piers and jetties.

Hafen A serves only to give access to the other basins, except at the eastern end where there are the 1,250-ft. quay fronting the *Deschimag* shipyard and four slips—three longitudinal and one broadside. Hafen B (Hütten Hafen), besides giving access to Hafen G (Öl Hafen), serves the blastfurnace plant on the west side, belonging to *Norddeutsche Hütte A.G.*, where there is an offset metal pile quay with six electric bridge cranes. On the east side is a well-equipped coaling quay. Öl Hafen is used principally by the *Deutsche Vacuum Öl A.G.* Kohlen Hafen is equipped with bridge cranes for coal handling; the east side is backed by the *Weser Aussenwerk* aircraft component works. In Kali Hafen, on the west side, there is about 1,000 ft. of quay specially equipped with bridge cranes and transporters for the loading of fertilizers. Hafen E is used for unloading timber. By 1944 the outline of Hafen F had undergone considerable change owing to war-time construction works.

The City Harbour. The six tidal basins of the city harbour comprise the following (from north-west to south-east): Werft Hafen, Vorhafen, Getreide Hafen (Hafen III), Holz und Fabriken Hafen, Übersee Hafen (Hafen II), and Europa Hafen. The first five basins are approached from the Weser by a common entrance, 240 yds. wide; only Europa Hafen has a separate direct entrance, which is 67 yds. wide. Übersee Hafen and Europa Hafen together form the Free Harbour of Bremen. Details of the basins are given on next page.

The Werft Hafen belongs to the *Deschimag* shipbuilding company (see p. 34); it is separated from the Weser by a narrow mole which is not suitable for berthing. Vorhafen and Getreide Hafen serve for turning and entrance to the longer basins to the east. In Getreide Hafen, however, there are two grain piers, about 525 ft. long; each pier is served by eight grain elevators, four on each side, while at the root of the piers there is a large grain warehouse. In Holz und Fabriken Hafen, the Hansa Quay to the north-east is backed by a vegetable oil refinery and two rice mills, and is equipped with four grain elevators. The south-west side of the basin is normally used for the timber trade. Übersee and Europa Hafen form the busiest part of the port, and are well equipped with lifting appliances and rail tracks. Hohentors Hafen is a long and narrow basin on the south bank, with an entrance depth of 13 ft., including a coal discharging berth for the state gasworks.

	Length, ft.	Width, ft.	Depths below chart datum, ft.	Length of quayage, ft.	No. of quay cranes
Werft Hafen (*Deschimag* shipyard)	3,000	450	25	4,020	11
Vorhafen (Turning basin)			25		
Getreide Hafen			23–24½	1,175 (grain piers)	(16 G.E.)
Holz und Fabriken Hafen:	3,930	300			
Hansa Quay			21	1,770	6 (4 G.E.)
South-west Quay			15–7	3,620	
Übersee Hafen:	5,400	300–360			
Barkhausen Quay			27	5,500	63
Marcus Quay			25	4,900	45
Europa Hafen:	5,700	360			
Buff Quay			11–16	5,900	53
Franzius Quay—					
N.W. Portion			10–11	2,050	—
S.E. Portion			12–17	3,950	46
R. Weser, east of lock:					
Jetty			29	650	
Mole			29	360	
Atlas Werke Quay			?	880	2
Weser Bahnhof Quay			15–16	1,600	14

Port Facilities

Warehouses are numerous, and in peace-time provided ample storage facilities. They have been largely devastated by air attack and will require much rebuilding. There are no dry docks in the port although work has been started on the construction of a dry dock over 1,000 ft. long at a site to the west of Werft Hafen. There were three floating docks (two are now sunk) in the Werft Hafen (622 ft., 490 ft. and 425 ft. long) and two small floating docks near the entrance to Europa Hafen (196 ft. and 147 ft. long). The slips within the shipbuilding yards are as follows:

Deschimag

Slip	1	435 ft.	Werft Hafen
	2	450	
	3	550	
	4	610	
	5	750	

Deschimag

Slip 7	350 ft.	Hafen A
8	350	
9	350	
10	600*	
11		

* Broadside.

Atlas Werke A.G. possess a broadside slip 440 ft. long, and 880 ft. of quay: *Roland Werft* has a 210-ft. broadside slip (this yard is some distance upstream, above the city).

Bremen is one of the most important individual shipbuilding centres in Germany, and the Weser as a whole (i.e. including the yards at Bremerhaven-Wesermünde and Vegesack) ranks second only to the Hamburg area. In peace-time the *Deschimag* yard in Werft Hafen built naval and merchant vessels of the largest types, e.g. the liners *Scharnhorst* and *Gneisenau* (18,000 tons), and the *Bremen* (51,700 tons). There is an extensive series of shops covering a large triangular site. *Atlas-Werke A.G.* normally builds vessels up to 1,300 tons, and is also described as the leading producer in Germany of ships' propellers. After 1939, it constructed U-boats and supersonic devices of various kinds. The works are now largely destroyed.

Administrative Relations between the towns of Bremen and Bremerhaven-Wesermünde

Bremen, a Reich Federal State, lies on both sides of the Weser and has two separate territories—Bremen proper and Vegesack. Until 1941 Bremerhaven was also part of Bremen's territories.

Bremen. Bremen proper (population 341,000 in 1938) includes an urban district and an adjacent rural district. Most of the urban district (32 sq. miles) lies on the right bank of the river, but the *Neustadt* (New Town), the *Südervorstadt* (southern suburb) and Woltmershausen are on the left bank, while the Werder district occupies a spit of land at the junction of the Weser and the Little Weser. The marshy rural district surrounding the town forms part of the Federal State of Bremen. It includes the Werderland, the Blockland and the Hollerland on the right bank of the river and the Nieder Vieland and Ober Vieland on the left bank.

Vegesack. Vegesack (population 4,574 in 1933) lies 9 miles below the town of Bremen where the Weser is joined by the Lesum (or Wümme). The first harbour there was built in the seventeenth

century. Vegesack was raised to the status of a town in 1850. It is a small enclave in the Prussian province of Hanover.

Bremerhaven-Wesermünde. Bremerhaven-Wesermünde (population 114,000 in 1941) is situated on the right bank of the Weser, and extends on either side of the confluence of that river and the Geeste. Bremerhaven was built in 1827–30 by Bremen as an outport (on land bought from Hanover) and it has subsequently expanded. Its population in 1933 was only 25,799. But its development was hampered somewhat by the fact that the Hanoverian (later Prussian) towns of Lehe, Wulsdorf and Geestemünde—united in 1924 under the name of Wesermünde (population 82,000 in 1938)—grew in the immediate vicinity. In 1941 Bremerhaven and Wesermünde were united and both now lie in Prussian territory, although the port of Bremerhaven continues to be administered from Bremen. The river Geeste which divides the twin ports is crossed by several road and rail bridges.

The City

The nucleus of the Old Town (or Bishop's Town) of Bremen developed on the right bank of the Weser around the cathedral and market square. There was some urban expansion in the middle ages to the north-east along the right bank of the river. The *Stephansstadt* district dates from about 1300. By the end of the middle ages the town was rectangular in shape and was protected on the one side by walls and on the other by the river. To-day parks (the *Wallanlagen*) lie on the site of the walls to the south of the moat. The most important medieval buildings that survive are ecclesiastical—for example the eleventh-century Cathedral and the thirteenth-century *Martinikirche.* The old municipal and business premises were for the most part built in the fifteenth and sixteenth centuries. They include the Old Town Hall, the City Weigh House, the Granary and the Crafts House.

Between 1622 and 1626—at the beginning of the Thirty Years War—the regularly laid out New Town was established for military reasons as a defensive bridgehead on the left bank of the river. Outside the walled New Town there subsequently developed the suburbs of Woltmershausen in the north-west and the southern suburb (Süder-Vorstadt) in the south. Modern buildings that deserve mention are the Bourse (1869), the new Town Hall (1909–12), the Cotton Exchange and the offices of the North German Lloyd shipping company. Bremen's modern suburbs cover a wide area

since—unlike most German urban residential districts—they consist not of flats but of small houses each occupied by one family only.

The Weser at Bremen is crossed by the Lüderitz Bridge, the

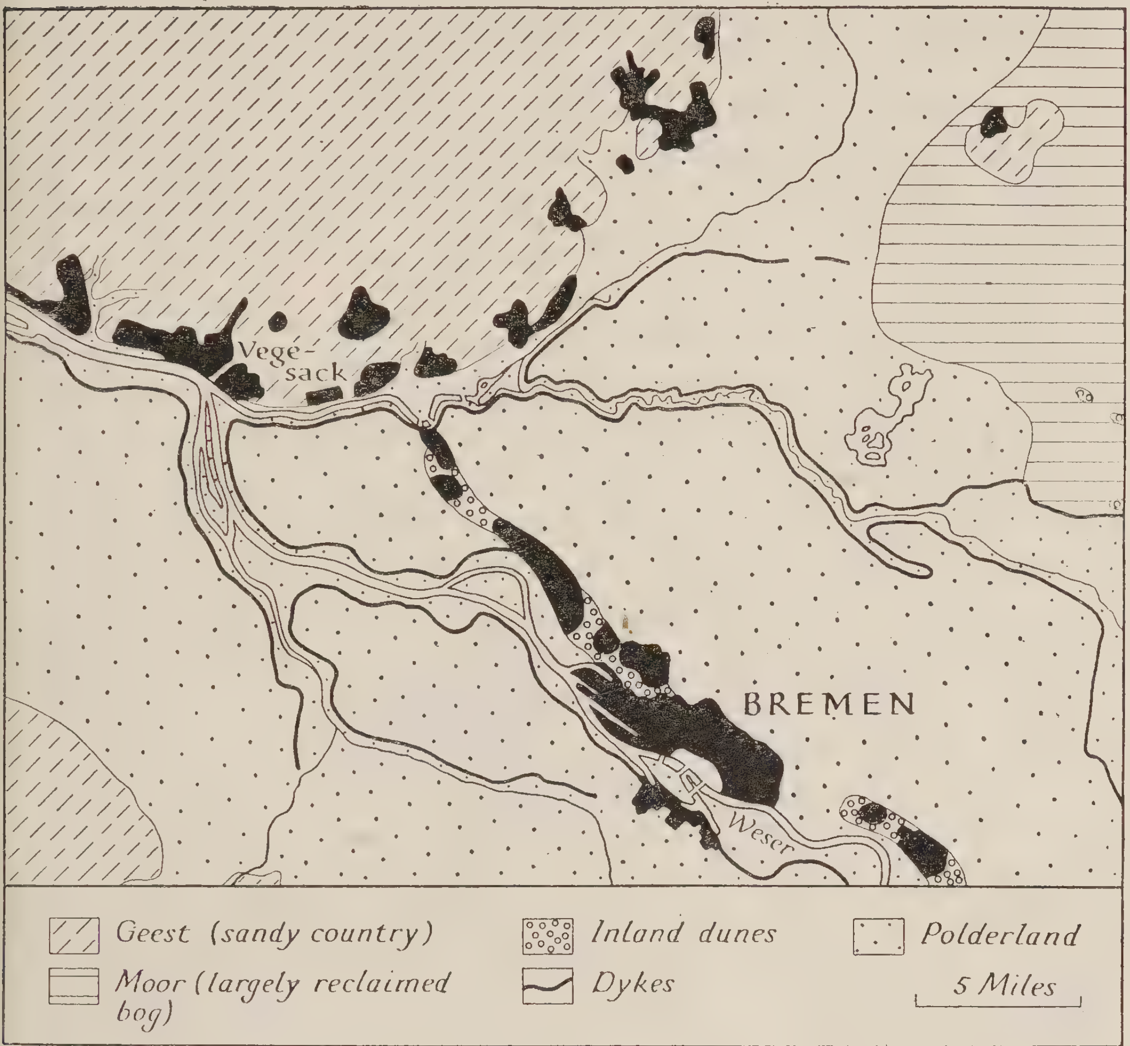

Fig. 12. The site of Bremen

Based on G. Braun, *Deutschland*, p. 80 (Berlin, 1936).

The main built-up areas are shown in black. A line of inland sand dunes provides a dry site for Bremen and its suburbs, giving the urban area an unusual shape. Around it lie *marschen*, formerly flooded by high tides, but long reclaimed into polderland; only the main dykes are shown. To the east and west of Vegesack the north bank of the Weser, and of its tributary the Lesum, cut sharply against the low sandy hills of the *geest* country, providing convenient sites for the string of small towns from Blumenthal, in the west, through Vegesack to Scharmbeck in the north. The important industrial satellite of Delmenhorst lies on the *geest* country to the south-west, part of which appears on the map.

Kaiser Bridge, and the Adolf Hitler Bridge, while the *Brautbrücke* and the *St Pauli Brücke* cross the Little Weser. Ferries also link the old city with the newer suburbs.

Before 1933 the municipality was administered by the *Magistrat*

(14 members) and 120 Town Councillors. These two bodies acted also as the Senate and Lower House (*Bürgerschaft*) of the Federal State of Bremen. After the Nazis gained power a single *Reichsstatthalter* was appointed for both Bremen and Oldenburg. He lived in Oldenburg and had a representative in Bremen. Offices of the

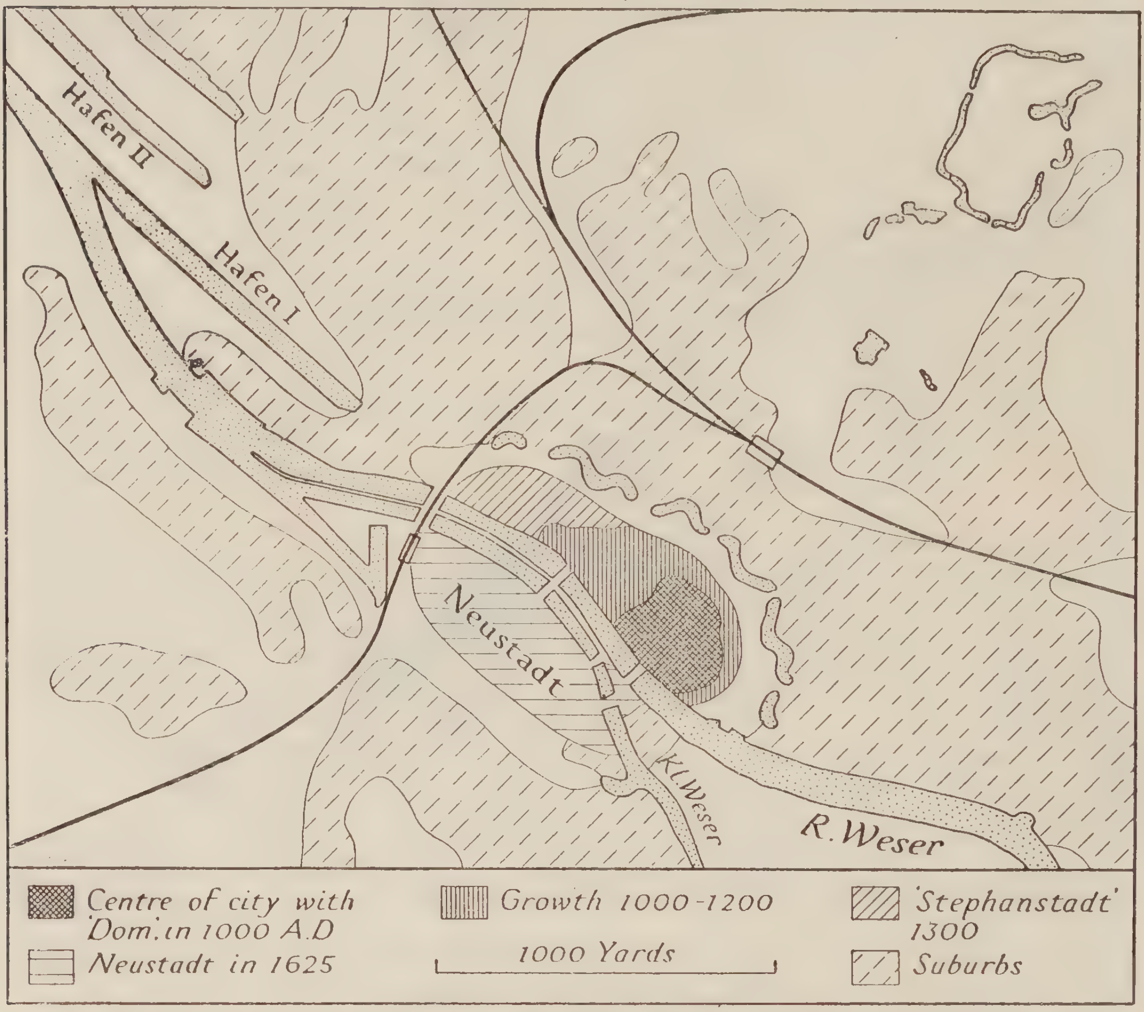

Fig. 13. The growth of Bremen

Based on G. Braun, *Deutschland*, p. 83 (Berlin, 1936).

The plan illustrates the expansion of the city from the earliest settlement. The medieval urban areas lay on the right bank of the river Weser—the original 'Cathedral Town', the extension of 1000–1200 A.D., and the *Stephansstadt* of c. 1300 A.D. The seventeenth-century 'New Town' grew up on the left bank of the river. The suburbs of the eighteenth and nineteenth centuries spread mainly on the right bank owing to the restricted area of ground suitable for building.

Reich in Bremen include those for the administration of central banking (*Reichsbank*), finance (the *Landesfinanzamt* Weser-Ems and three revenue offices), customs (*Hauptzollämter* for E. Bremen, W. Bremen and the Harbour), economic affairs (*Landeswirtschaftsamt*), the post office (*Oberpostdirektion*), civil defence (*Behörde*

für Luftschutz) and military and naval affairs. Bremen is the seat of a Town Court and a District Court. Appeals are heard in Hamburg.

Bremen is important as a centre of culture and learning. Its higher educational institutions include a Technical College, a Nautical School, an Art School, a Commercial College and a Teachers' Training College. There is a Meteorological Observatory and a Moorland Experimental Station (*Moorversuchsstation*).

As a result of air attack the city has suffered severely and large areas will have to be entirely rebuilt.

History

Bremen probably developed from a fishing and trading settlement on an island at the lowest point where the Weser could conveniently be crossed. A bishopric was established at Bremen in 788 A.D. in the time of Charlemagne. In the middle of the ninth century it was removed from the authority of the Archbishop of Köln. The Bremen diocese was united with that of Hamburg and was raised to the status of an archbishopric. (The transfer of the administration from Hamburg to Bremen was finally made in 1223.) Bremen became the focus of missionary activity among the heathen of northern Europe, and under Archbishop Adelbert (1043–72) town and see attained their first period of prosperity and influence.

In the tenth century Bremen received market privileges. In the middle ages it was a great centre of commerce on the important land and sea trade route along the shores of the Baltic and North Sea which linked Scandinavia and eastern Europe with Flanders. Flemish and German woollen goods, for example, were exchanged for Russian furs. Bremen traded with Flanders (particularly Utrecht), England, Spain, Portugal and southern Germany. Her ships ventured to Wisby, the Shetlands and Iceland. By the thirteenth century the patrician families had gained for the town a position of virtual independence from the ecclesiastical authorities.

For four hundred years Bremen kept free from tolls the Weser route-way by which her merchandise reached Celle and Brunswick. The Bremervörde Pass permitted the carriage of goods to markets between the Weser and the Elbe. Bremen also traded with Westphalia and the Rhineland. In the fourteenth century the territorial expansion of Bremen began on a modest scale. First the Vieland district south of the Weser was secured. Then a fortified bridgehead (*Schanze*) was secured on the bank of the Lesum to the north of the town. The marshy districts of Werderland, Hollerland and Blockland

were also gained. Between 1375 and 1382 Bremen gained new lands on the lower Weser, e.g. Langwedel, Stotel, Wildeshausen, Thedinghausen, parts of Delmenhorst and Bederkesa. Some of these territories (Langwedel, Stotel and Wildeshausen) were soon lost again, but the remainder came definitely into Bremen's possession in 1541. Part of Borgfeld was purchased in 1595.

In the thirteenth century Bremen had joined the Hanseatic League but, owing to disputes with the other members, she was excluded in 1285–1358 (when she refused to fight Norway) and again in 1427–33. In the fifteenth century Bremen's trade suffered owing to wars with Burgundy (1468–74) and unsatisfactory relations with France. During the great Age of Discovery Bremen ships visited the Canary Islands, the West African coast and Brazil. The Reformation was introduced into the town in 1522 and into the Archbishopric a little later. Bremen was a member of the Schmalkaldic League and suffered in the religious wars of the sixteenth century. Imperial troops twice besieged the city in 1547.

The growth of the power of the German princes at the Emperor's expense in the seventeenth century led to the establishment of many vexatious internal tolls in Germany which hampered Bremen's commerce. In 1598 twenty-one tolls were levied on the river Weser between Bremen and Minden. In 1653 Bremen had to accept the levying of tolls at Elsfleth (on the left bank of the lower Weser) by the Duke of Oldenburg. In 1646 Bremen became a Free Imperial City. Two years later at the Peace of Westphalia Sweden annexed the lands of the Archbishopric * and in 1654 she seized Bederkesa and Lehe from the city.

Despite these difficulties Bremen made some economic progress in this period. Since larger merchant ships were now being built and it was often difficult for them to reach Bremen, a new harbour was built in the early seventeenth century at Vegesack on the right bank of the Weser just below the city. In the second half of the seventeenth century the tobacco industry was established in Bremen and the whaling voyages to Greenland were very profitable. At this time some of Bremen's chief exports were linen to England and herrings to Holland, while her imports included tobacco and textile goods from England and wine and silk from France.

* In 1715 the territories of the Duchy (formerly Archbishopric) of Bremen fell to Hanover, where they remained—except for a brief interval during the Napoleonic Wars—until 1866. Then, with the rest of Hanover's territories, they were annexed by Prussia. The territories which had once formed the Duchy of Bremen (with Verden and Hadeln) became the *Regierungsbezirk* of Stade.

Fig. 14. Bremen

Based on official sources.

fd. Floating docks; G.S. Goods station; 1 Hansa Quay; 2 Barkhausen Quay; 3 Marcus Quay; 4 Buff Quay; 5 Franzius Quay; 6 *Deutsche Vacuum Öl A.G.*; 7 Timber yard; 8 *Weser Flugzeugbau G.m.b.H.* (aircraft components); 9 Grain silos; 10 Post Office administration building; 11, 12 Oil mill; 13 Harbour administration; 14 Jute mill; 15 Tobacco factory; 16 Harbour office; 17 Gasworks; 18 *Norddeutscher Lloyd* building; 19 Cathedral; 20 Lüderitz bridge; 21 Waterworks; 22 Tobacco factory; 23 *Focke-Wulf G.m.b.H*; 24 *Hansa-Lloyd-Goliath* motor works; 25 *Lloyd Dynamowerke A.G.*; 26 Power station (thermal); 27 Cotton sheds; 28 *Roland-Werft G.m.b.H.* The Altstadt is the compact built-up area around the cathedral (19); nearby are the oldest churches, the Rathaus, law courts, police headquarters, stock exchange, cotton exchange and main post office. The Grosse Weser Bridge was renamed Adolf Hitler Bridge.

Hitherto Bremen's importance had lain in her commerce, her shipping and her fishing. In the eighteenth century the port began to develop as an industrial centre. To the existing tobacco manufacture were added shipbuilding yards; a textile industry; and sugar refineries. At the same time Bremen profited as a commercial centre from the decline of Holland, from the Anglo-French wars, and from the rise of the independent United States. There was a flourishing trade with France and England and (after 1783) with the United States. In 1769 Bremen's first mercantile insurance company was established. By the end of the eighteenth century there was a substantial increase in imports of tobacco, rice, syrup and sugar. These 'colonial goods' were destined for markets in Germany and other parts of central Europe.

The Revolutionary and Napoleonic Wars adversely affected the overseas trade of the city. After a brief period of prosperity came the British blockade of the Weser estuary (1803), the establishment of the Continental System by Napoleon (1806), the occupation of Bremen by French troops (November 21, 1806) and the incorporation of the city in the French Empire. Between 1810 and 1813 it was the capital of the Wesermünde Department.

In 1815 Bremen recovered its status as a Free City and it became a member of the newly established Germanic Confederation (*Bund*). Its territories outside the city proper included only the marshy districts immediately adjacent and also Vegesack. There was no immediate revival of trade after the Napoleonic Wars, partly because Germans could not afford to buy many goods from abroad. Commerce was fostered by the abolition of the Elsfleth toll (1820), the amalgamation of numerous dues on the river Weser into a single shipping tax (1823), the Commercial Treaty of the Hansa Towns with Britain (1825) and—above all—by the construction of the outport of Bremerhaven (1827–30).

The Duchy of Oldenburg controlled the left bank of the lower Weser, and even after she had to give up the Elsfleth toll she tried to gain commercial advantages by hampering the passage of ships to Bremen. Burgomaster Schmidt promoted the scheme for the construction of a new outport below Bremen on the right bank of the Weser where Oldenburg could not interfere with the traffic. The necessary land at the junction of the Weser and the Geeste was acquired from Hanover. The work of building the first modern harbour at Bremerhaven was carried out by Van Ronzelen, and in 1830 Bremen possessed a fine outport capable of handling large

vessels. It was not until 1847 that Hanover began to build the rival port of Geestemünde. Modern docks were constructed there in 1857–63.

In the thirties Bremen began to develop as the leading continental port for passenger traffic across the North Atlantic. Many emigrants from central Europe went to America by way of Bremen and in 1862, for example, nearly 60,000 emigrants used the port. In 1836 ships from Bremen began to go on whaling expeditions to the South Pacific. Largely owing to the energy of Burgomaster Arnold Duckwitz a steam tug company began to operate on the upper Weser in 1839 and the *Gesellschaft der vereinten Weser-Dampfschiffahrt* carried passengers and express goods on the navigable Weser in 1843. The port's transport facilities were further improved in the forties and fifties by the opening of the Bremen-Wunstorf railway (1847); by the construction of a new harbour in Bremen (1847–51); and by the building of the Hoheweg Lighthouse at the Weser mouth (1856).

In the early forties the city's mercantile marine was twice as big as that of Hamburg, and in 1848 there were 246 sailing ships and eight steamships under its flag. Eleven shipowners each owned more than five vessels. The year 1857 marked an important stage in the development of Bremen. In this year H. H. Meier founded the North German Lloyd shipping company by combining four existing companies. The North German Lloyd became the largest shipping firm in Bremen and it concentrated upon the passenger traffic of the North Atlantic. Its first steamers came from British yards. Meier had already been responsible for the founding of the Bremen Bank.

While Bremen exported men rather than goods in the nineteenth century, linen remained important as an export until the middle years of the century, and some manufactured goods from the Ruhr and southern Germany (e.g. Nuremberg) were exported. The principal imports were tobacco, wine, rice, sugar, coffee, hides and petroleum. Bremen became the greatest market in the world for tobacco. For many years her cotton came from Liverpool and not direct from the United States. In the eighties, however, Bremen shippers became more and more independent of British importers and brought cotton direct from America. Rice came first from Carolina and later from south-eastern Asia. Wine came mainly from France. The import of petroleum began in the sixties.

Industry increased as well as commerce. In 1822 the first iron-

works were established by Unthoff in Vegesack. The number of factories engaged in making tobacco increased from 78 in 1839 to 290 in 1852; there was a flourishing brewing industry, and the Oldenburg cork industry was dominated by Bremen merchants and financiers. At Bremerhaven shipbuilding yards were established by R. C. Rickmers (1839), J. L. Tecklenborg (1841) and G. Seebeck (1855).

In the sixties and seventies the further development of railways in North Germany fostered the commerce at the port. The Weser railway was opened in 1860; the line from Bremen to the outports of Bremerhaven and Geestemünde in 1862; the Bremen-Oldenburg railway in 1867; and the Osnabrück-Bremen-Hamburg line in 1873–4. Bremen came to depend very largely upon railways and did not use the Weser to the extent that Hamburg used the Elbe. Communications by sea benefited from the establishment of the Nautical and Meteorological Institute (*die norddeutsche Seewarte*) by Hamburg and Bremen in 1867 and from the erection of the Rotesand Lighthouse (1882–7).

As a great port with a large transit trade Bremen's commercial policy in the nineteenth century was not unnaturally that of Free Trade. The *Weser Zeitung*—published in Bremen between 1844 and 1934—was for many years one of Germany's leading Free Trade and Liberal newspapers. In the twenties and early thirties of the nineteenth century Bremen had viewed with some anxiety the persistent efforts of Prussia to extend her customs system to neighbouring German states. Bremen joined the short-lived Middle German Commercial Union which endeavoured to maintain routes from Bremen to the great markets of Frankfurt-am-Main and Leipzig free from Prussian control. But this Union collapsed and Prussia formed the Zollverein in 1834. Hanover joined the Zollverein twenty years later. By that time Bremen had long realized that the Zollverein had come to stay. In 1856 a Treaty between Prussia and Bremen provided for the establishment of a Zollverein customs house (*Hauptzollamt*) and bonded warehouse (*Zollvereinsniederlage*) in Bremen territory. In 1869 Prussia—which had annexed Hanover two years before—granted Bremen additional territory near Bremerhaven so that the docks of the outport might be extended. It was not until 1884 that the city accepted the German customs system and then only on condition that she might have a large Free Port. This Free Port was built between 1885 and 1888. At the same time the city authorities launched a great scheme for improving navigation

on the lower Weser. This was accomplished by the engineer Ludwig Franzius in the late eighties.

Meanwhile Bremen had joined first the North German Confeder-

Fig. 15. Hamburg, Bremen and the Zollverein, 1868

Based on W. O. Henderson, *The Zollverein*, p. 312 (Cambridge, 1939).

Commerce on the lower Elbe and lower Weser was hampered in the middle years of the nineteenth century by the political geography of Germany: on the Elbe the trade of Hamburg suffered to some extent from the rivalry of Denmark (Holstein) and Hanover, and on the Weser Bremen was similarly hampered by Hanover and Oldenburg. The expansion of Prussia in the sixties—by the annexation of Holstein and Hanover—simplified the political geography of this part of Germany. In the fifties and sixties, Prussia—on behalf of the Zollverein—arranged with both Hamburg and Bremen exchanges of territories as far as customs administration was concerned. Thus the Prussian city of Altona (Holstein) was excluded from the Zollverein, while the Hamburg territory of Cuxhaven-Ritzebüttel at the mouth of the Elbe estuary was included in the Zollverein.

ation (1867) and then the German Empire (1871). In 1867 she gave up to Prussia control of her military affairs. The establishment of a strong central authority in Germany ended—to a great extent—the

senseless rivalry of three Federal States on the lower Weser. Hitherto the Free City had controlled Bremen proper, Vegesack, and (lower down the river on the right bank) Bremerhaven. Hanover had held the right bank of the lower Weser—including Blumenthal, Geestemünde and Lehe. Oldenburg had controlled the left bank of the river on which lay Einswarden, Nordenham, Brake, Elsfleth and (a little inland) Delmenhorst. The competition between Bremen, Hanover and Oldenburg had, to some extent, hampered economic progress on the lower Weser. In 1866 Hanover was annexed by Prussia, who showed herself to be an accommodating neighbour to Bremen. The continued division of the lower Weser district into three local government areas was, however, by no means entirely satisfactory. (The Prussian towns of Geestemünde and Lehe were united in October 1924 and are now called Wesermünde.)

Bremen continued to make progress as a member of the new Reich—particularly after she joined its customs union. Important new shipping companies were formed—the *Neptun* in 1873; the *Hansa* (by Papendiek) in 1881; and the *Argo* in 1896. The North German Lloyd held the Blue Ribbon of the Atlantic between 1897 and 1900 with its German-built liner the *Kaiser Wilhelm der Grosse*. The big Bremen shipping firms swallowed smaller rivals. By 1910 the two largest firms—the North German Lloyd and the *Hansa*—accounted for no less than two-thirds of the whole Bremen mercantile marine. The Free Port (outside the customs system of the Reich) was completed in 1888 and extended in 1906 (Dock II) and 1913 (Dock III); the 'Holz und Industrie Hafen' was opened in 1891 and extended in 1899; the three Kaiser Docks were completed between 1906 and 1909. The Bremen mercantile marine in 1914 consisted of just over 700 ships of nearly 1,470,000 tons—well over a quarter of the whole German merchant navy. The 135 steamships of the North German Lloyd alone accounted for 982,952 tons.

Emigrant traffic continued to be important. After the establishment of the Empire the peak year was 1881 when 98,510 emigrants left Bremen. By the turn of the century the figure was under 10,000, although in 1910 it reached nearly 14,000.

Industrial progress too was made. The *Norddeutsche Wollkämmerei und Kammgarnspinnerei* was established in 1882 and the *Bremer Wollkämmerei* (Blumenthal) in 1883. At Hemlingen, near Bremen, one of the first jute factories to be set up in Germany was established in 1873. Commercial and industrial progress was reflected in the growth of population:

	Bremen	Vegesack	Bremerhaven
1812	35,000		
1830			170
1855	67,000	2,400 (1860)	6,300 (1860)
1890	144,000		15,000 (1885)
1902	186,622*	4,112 (1905)	20,315 (1900)
1911	252,000		24,125 (1910)
1925	294,900	4,300	23,896

* Old Town 19,637; New Town 14,167; Suburbs 132,347; Outer Suburbs 20,671.

Some changes in Bremen's commerce after 1871 deserve notice. The completion of the German railway system led the city to rely more upon railways and less upon roads and inland waterways for the distribution of goods to continental markets. Tobacco and cotton continued to be staple imports. The petroleum trade fell entirely into American hands. Nevertheless, wool imports increased, and silk from eastern Asia began to be imported in the nineties. The wine trade with France increased in the twentieth century. There were changes in the grain trade. In 1860–90 rye (from Russia) was the chief grain to be imported; other supplies came from Roumania and America. From the nineties onwards maize for fodder (from Russia) tended to replace rye for human consumption as the principal grain import. After 1900 barley imports increased. Bremen's importance as a timber harbour greatly increased after the opening of a special Timber Dock in the eighties. The imports of oranges, lemons, bananas, pineapples and grapes increased. Coffee was imported for sale in Germany (about 400,000 bags in 1914) and for re-export to Austria, Russia, the Balkans and Scandinavia.

Value of average annual trade of Bremen in the nineteenth century (in million Marks)

	Imports	Exports
1847–51	105	92
1857–61	222	203
1867–71	353	330
1877–81	494	474
1887–91	657	619
1897–1901	981	935

From: *Meyers Grosses Konversations Lexikon*, 6th edn., vol. III, p. 380 (Leipzig, 1909).

Exports which had declined in the sixties revived somewhat in the seventies. Many new overseas markets—particularly in Africa and South America—were opened up by Bremen merchants. The

close association with the German overseas empire of 1884–1914 was symbolized by the fact that one of her merchants (Adolf Lüderitz) was mainly responsible for the founding of Germany's colony in South-West Africa.

The war of 1914–1918, during which the German ports were blockaded, struck a severe blow at shipping and overseas trade. The bulk of Germany's mercantile marine had to be surrendered to the victorious Allies—the North German Lloyd alone lost 869,000 tons—and only some 60,000 tons of inferior shipping was left to Bremen. Vigorous efforts were made to establish a new mercantile marine—with the aid of state subsidies. As early as 1922 the port had a fleet of almost entirely new ships of 150,000 tons. In 1939 it had 76 ships of 572,376 tons, and had again become the leading harbour in the Reich for the importation of cotton, tobacco and grain.

The fortunes of other Bremen industries were similar to those of the Reich as a whole. The depressed conditions immediately after the war of 1914–1918 were followed by a brief period of prosperity fostered by foreign loans. Then came the crash of 1931 when the bankruptcy of the *Norddeutsche Wollkämmerei* of Bremen was largely responsible for the collapse of one of the great German banks (the *Darmstädter Bank*). Subsequently industries of the port revived, mainly owing to the rearmament policy of the Nazi regime.

During the present war a simplification of urban administration in the lower Weser district took place. The outport of Bremerhaven was taken from Bremen and was incorporated with the neighbouring Prussian town of Wesermünde—itself a recent (1924) amalgamation of several formerly separate urban districts.

Trade

The totals for cargo passing through Bremen itself in 1936 and 1937 were as follows:

Traffic, 1936, 1937 (*in thousands of tons*)

	Total	Coastwise		Foreign	
		Outwards	Inwards	Outwards	Inwards
1936	6,221·1	645·9	643·7	3,398·0	1,533·5
1937	7,457·7	609·0	664·2	4,062·4	2,122·1

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

The coastwise trade shows an approximate balance in each direction; foreign trade, as might be expected, shows a considerable inward excess. Detailed statistics of the trade of Bremen alone are not available: the trade of all the 'Bremische Häfen' may be summarized as follows (in thousands of tons):

Coastwise trade	Outwards	Inwards
East Prussia	165	120
Stettin	31	37
Other Pomeranian ports	12	92
Hamburg	177	385
Oldenburg	90	6
Other North Sea ports (excluding also Emden	126	18
Total	631	700
Foreign Trade	4,126	2,628

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, pp. 49–57.

The largest outward items in the coastwise trade were cement (130,000 tons) and earth, sand, etc. (167,000 tons). The largest inward item was grain (195,000 tons). The remainder of the coastwise trade was distributed over a great variety of commodities.

In the foreign trade the chief commodities dealt with were (in thousands of tons):

Exports		Imports	
Coal	1,418	Iron and manganese ores	510
Coke	379	Petroleum derivatives	291
Iron and steel	644	Coal	86
Iron and steel goods	111	Timber	302
Machinery	54	Cotton	286
Potash	448	Wool	62
Chemicals	218	Maize	152
Paper, pulp	95	Fruit	85
		Paper, pulp	79
		Oilseeds	62
		Coffee	20
		Tobacco	18

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, pp. 48–57.

The greatest weight of commodities was exchanged with European countries rather than with more distant countries. The largest single receiver of exports was Italy—860,000 tons, of which 839,000 tons were coal. The Scandinavian countries received coal and supplied most of the iron ore. Exports of iron, steel, and machinery were sent to a great variety of destinations; of the potash nearly half went to the U.S.A. Most of the petroleum imported was derived from 'Mittelamerika'. The coal import of 86,000 tons came entirely from Great Britain. Most of the timber imported came from east Baltic

Plate 5. Bremerhaven: North Lock, looking south
In the left background a liner can be seen alongside the Columbus Quay.

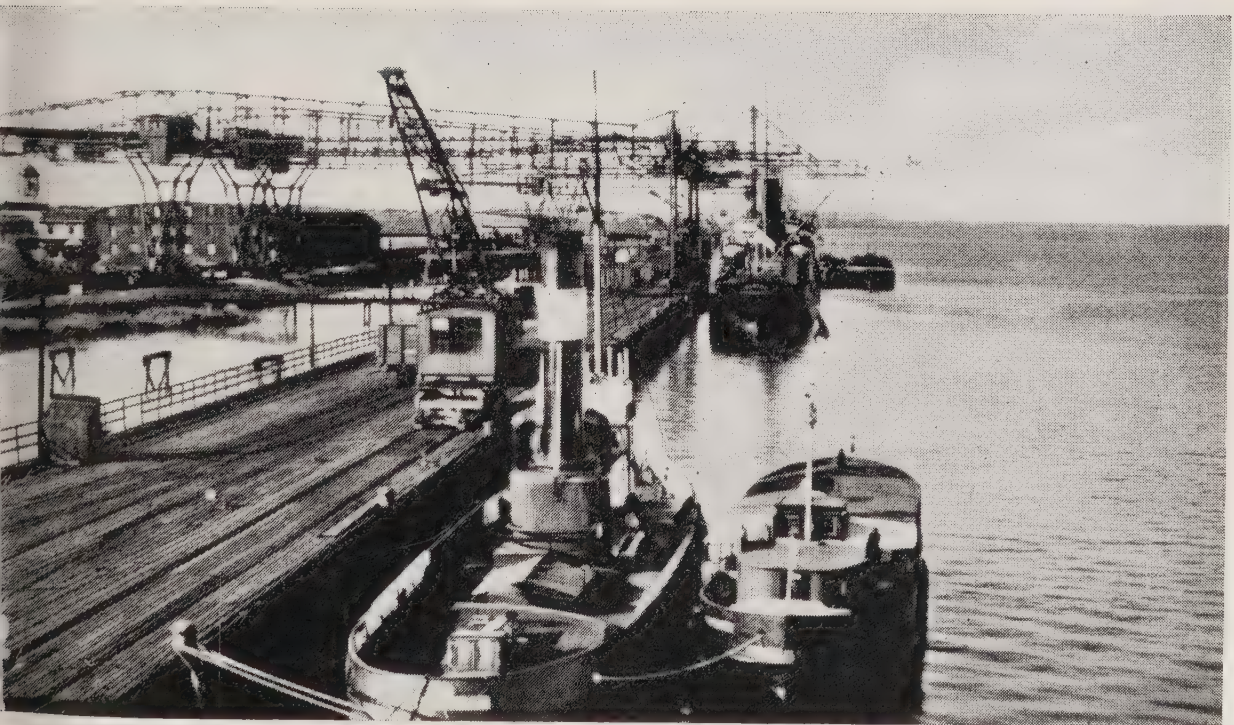

Plate 6. Nordenham: Midgard Pier, looking north

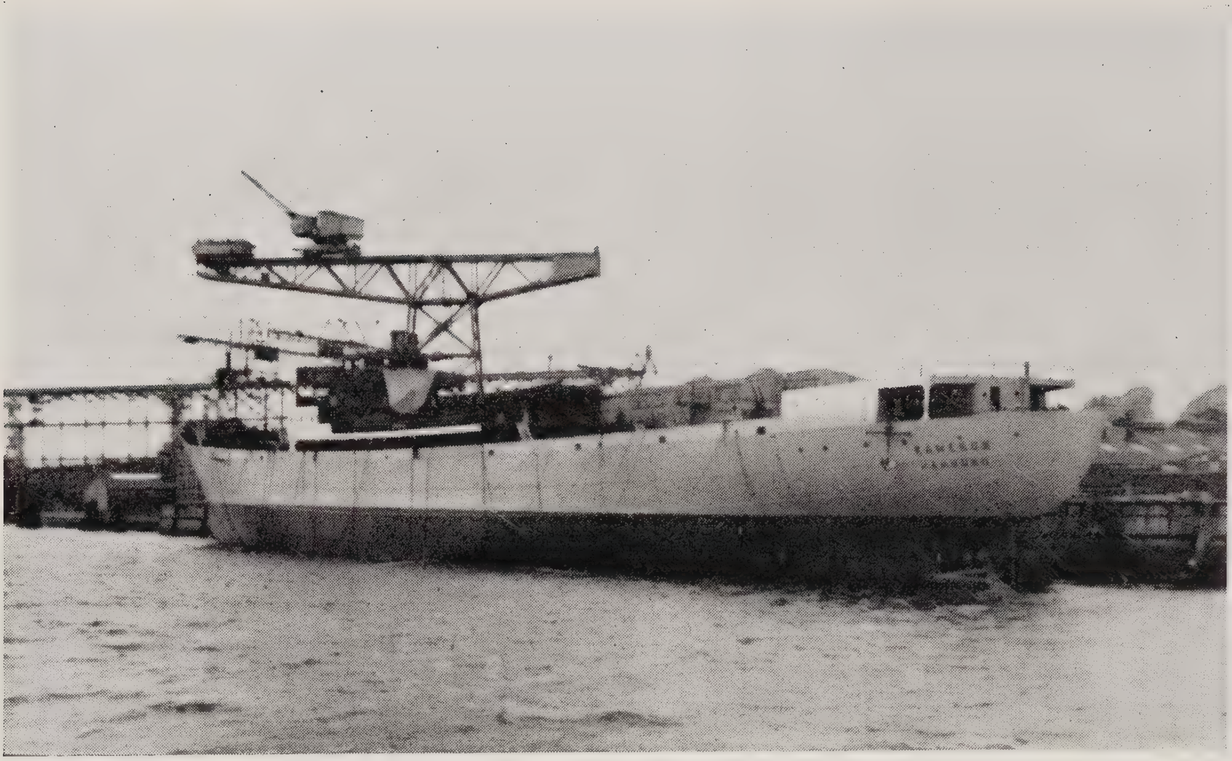

Plate 7. Vegesack: *Bremer Vulkan* yards

The *Kamerun* (*Woermann Linie A.G.*), a motor vessel of 5,000 tons gross, was completed in 1938.

Plate 8. Bremen: Hütten Hafen (Hafen B)

Across the basin are the *Norddeutsche Hütte A.G.* steelworks; in the foreground a coal-loading quay.

countries. Great Britain and South Africa supplied most of the wool, U.S.A. most of the cotton, Argentina and Roumania most of the maize.

In general, the trade of Bremen and Bremerhaven is distributed over a great range of commodities and countries. It resembles the trade of Hamburg, but on a smaller scale. The port imports more cotton and nearly as much wool, however, and much more iron ore. It exports much more coal. The import of tropical products is restricted in comparison with the import at Hamburg, but Bremen has retained its place as a cotton market; it is the largest cotton-importing port on the continent. Through a well-organized cotton exchange it supplies not only German mills, but the cotton industries of Austria, Czechoslovakia and Switzerland.

Liner Traffic. Bremen gains considerably from its position to the west of Hamburg. Many outward bound liners call at Bremen after leaving Hamburg, not merely to collect merchandise which would have been sent via Bremen in any event, but to pick up from quite distant sources merchandise which can be dispatched later than if it were sent via Hamburg. In the liner trade of the continental North Sea ports the Hamburg-Bremen-Rotterdam-Antwerp or Hamburg-Bremen-Antwerp run is very common. Comparatively few liners begin their voyages at Bremen (Fig. 25 and Appendix IV).

Waterway Traffic. The waterway connexions of the port are of considerable value although Bremen is primarily a railway port.

Waterway traffic of Weser ports, 1937 (*in thousands of tons*)

	Inwards	Outwards	Total
Bremen	2,139	501	2,640
Brake	26	195	221
Nordenham	185	42	227
Wesermünde	171	18	189
Bremerhaven	157	75	232

From: *Die Binnenschiffahrt im Jahre 1937*, pp. 8, 9.

Its waterway traffic has increased slightly since 1927, while that of Hamburg has declined. The chief commodities moving inwards to Bremen itself are coal (600,000 tons), earth, sand, etc. (613,000 tons), and potash (238,000 tons).

The future of Bremen is bound up in no small measure with the development of waterways in Germany. The virtual completion of the Mittelland C. has largely led to the undertaking of the canalization of the Weser (see p. 592). The completion of this work will give

Bremen improved and much more direct waterway access to the Ruhr for large barges, and more convenient access to central Germany and Berlin as well, and thus considerably improve its connexion with the hinterland. The projected Hansa C. (see p. 594) would give Bremen the most direct connexion with the Ruhr, and further improve its waterway facilities.

Railway Traffic. At present the railway traffic of Bremen is nearly four times the waterway traffic in amount. The port has the advantage over Hamburg of a shorter haul from the Ruhr, which enables it to act to a considerable extent as a port for the western industrial region.

Rail and water traffic at Bremen and Hamburg, 1937
(*in thousands of tons*)

	Bremen	Hamburg
Rail movement	9,448	11,706
Inwards	7,644	7,718
Outwards	1,844	3,988
Waterway movement	2,640	9,990
Inwards	2,139	4,590
Outwards	501	5,400

These figures include *Lokalverkehr*, i.e. goods put on rail or barge within the port for destinations within the port.

From: *Die Binnenschiffahrt im Jahre 1937*, pp. 6–7; *Die Güterbewegung auf deutschen Eisenbahnen, 1937*, Heft I, pp. 29, 35; Heft II, pp. 31, 37.

Bremen has been described as essentially a railway port. It handled, in 1937, a tonnage of railway freight which was not far below the figure for Hamburg, and the inward rail movements were very little inferior to those at Hamburg. A comparison of the two ports reveals interesting differences, arising largely from their position in relation to the chief centres of production in Germany. Bremen, lying farther west, received by rail more coal and iron and steel semi-manufactures from the Ruhr and more from the Saar. These products are sensitive to slight differences of haulage cost, and the shorter the distance over which they must be carried to Bremen for export gives that port an advantage over Hamburg. Iron and steel goods and machinery, on the other hand, are less sensitive to small differences in rail haulage cost. They are manufactured, furthermore, not only in the Ruhr, but in centres which are almost equally distant from both ports, such as Saxony and the Stuttgart area, or in the Greater Berlin district, which is considerably nearer Hamburg. Covering a great range of articles, they are exported to a very great variety of destinations, and are

therefore attracted by the greater number of liner sailings from Hamburg. These two groups therefore move mainly to Hamburg.

Among the import items, the inland movement of petroleum products from Bremen is very small, for the Berlin district is more

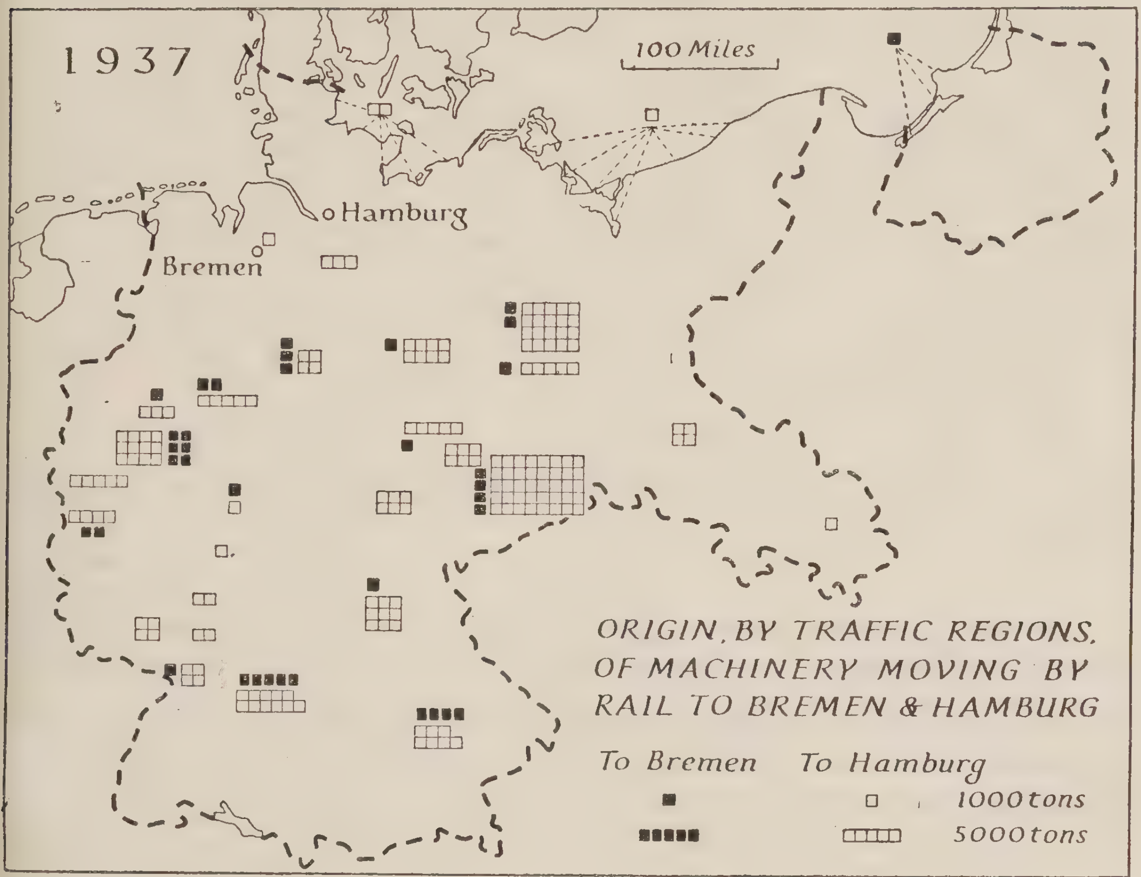

Fig. 16. Origin of machinery moving by rail to Bremen and Hamburg, 1937

Based on *Die Güterbewegung auf deutschen Eisenbahnen 1937*, Heft II, *passim* (Berlin, 1938).

The quantities shown include all machinery moving by rail; the greater part was for export. The symbols are located at the point of origin, viz. the various traffic districts employed in the returns of railway traffic (see p. 280, Fig. 63). A highly fabricated article like machinery does not always move to the nearest point for shipment, and Hamburg draws upon the west and south of Germany as well as the centre. Except for exports to Baltic countries, which move partly through Stettin, and for exports by rail to neighbouring countries, the map indicates the origin of practically all German exports of machinery: Berlin, Brandenburg, Saxony and south Germany stand out, while the Ruhr is relatively unimportant. The movement to other destinations within Germany is shown in Fig. 65.

easily supplied by Hamburg and the Ruhr by way of waterborne supplies from Rotterdam. The import of iron and manganese ores at both ports is comparatively small, but in rail movements to the Ruhr and even more so to the Saar, Bremen has an obvious advantage.

Movement by rail of certain commodities to the Ruhr and the Saar, 1937 (*in thousands of tons*)

	From Hamburg	From Bremen	To Hamburg	To Bremen
Ruhr				
Ores	—	131	—	—
Coal and coke	—	—	3,253	4,453
Iron and steel	—	—	205	743
Iron and steel goods	—	—	144	128
Machinery	—	—	30	11
Saar				
Ores	—	117	—	—
Coal and coke	—	—	—	—
Iron and steel	—	—	18	26
Iron and steel goods	—	—	1	1
Machinery	—	—	—	—

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937, etc.*, Heft I, pp. 25, 31; Heft II, 28, 31, 34, 37.

The raw cotton import of Bremen moves by rail to many destinations in Germany—the Ruhr (63,000 tons), Saxony (24,000 tons), Bavaria (46,000 tons) and Württemberg (19,000 tons), were the principal recipients. Hamburg sent more to Saxony, but less to the other centres. A good deal went to nearby foreign countries:

Rail movement of raw cotton from Bremen and Hamburg to foreign countries, 1937 (*in thousands of tons*)

Destination	From Bremen	From Hamburg
Hungary	2	1
Czechoslovakia	46	14·5
Austria	17	7
Switzerland	4	·3
Netherlands	5	—
Italy	—	1·4
Jugoslavia, Bulgaria, Turkey and Greece	4	1·5
All foreign countries	79	27

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937, etc.*, Heft I, p. 156.

Bremen distributed some imports to many parts of Germany: fruit, for example, is widely transported, and the port is nearly as important as Hamburg in supplying Berlin with fruit by rail. There is also a widespread distribution of fish from Wesermünde.

Rail traffic at the Elbe and Weser ports, 1937
(in thousands of tons)

	Elbehäfen	Weserhäfen
Inwards		
Total	7,718	7,644
Coal and coke	3,284	4,466
Lignite and briquettes	339	163
Iron and steel	435	844
Machinery	175	36
Iron and steel goods	312	172
Outwards		
Total	3,988	1,844
Petroleum products	1,062	—
Iron and manganese ore	90	263
Cotton	144	183
Fruit	94	65
Sawn timber	66	95
Fish and fish products	139	97
Total both ways	11,706	9,488

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937, etc.*, Heft I, pp. 24–9, 30–5; Heft II, pp. 26–31, 32–7.

Elbehäfen and Weserhäfen are traffic districts Nos. 8 and 9 respectively of the German railway traffic returns (see p. 280).

Shipping Lines. It is interesting to note that, although Bremen is much smaller than Hamburg as a port, it is not much inferior as a headquarters of shipping lines. In 1939 companies with Hamburg as the usual home port owned just over 1,500,000 gross tons, and companies with Bremen as the usual home port owned just over 1,000,000 tons.

Industries

The industries of Bremen are distinguished by their variety rather than by any striking concentration on a single activity. The entire Weser estuary is the most important shipbuilding centre in Germany after Hamburg; at Bremen itself there is only one big yard, although this yard (*Deschimag*) is the second largest in the country by slip capacity (see p. 34). The *Deschimag* yard constructs M.A.N.* diesel engines. The smaller *Atlas-Werke* yard, besides engaging in shipbuilding, produces a variety of components, and specializes in propellers. Among minor producers of ancillary equipment there is a firm specializing in navigation and signal lights. Bremen holds an important place in the development of ship design, and it was here that the 'Maierform' bow was developed.

Other metal industries are represented. The *Norddeutsche*

* *Maschinenfabrik Augsburg Nürnberg.*

Hütte A.G. blast furnace plant has a capacity of 170,000 tons of pig iron annually and also smelts nickel. The *Franke Werke A.G.* constructs waterworks, coke-oven, coal-handling and by-products plants. There is a manufacturer of lead pipes. Lighter industries comprise an important plant for the production of heavy commercial

Fig. 17. *Reichsstrassen* (main roads) leading to the German ports

Based on the map published by the *Deutsche Automobil-Club*, 1940.

The numbers are the *Reichsstrassen* classification numbers. The autobahnen connexions are shown in Fig. 113.

vehicles, which was converted to armoured vehicle construction; a small van and lorry works; and two aircraft plants, producing the *Weser* dive bomber and the *Focke-Wulf* fighter.

Industries directly using imported materials include one of the largest wool-washing and combing factories in Germany * and an

* At Blumenthal.

important woollen mill. Two large flour mills have an aggregate capacity of 550 tons per day. There are several chocolate factories. The tobacco factories of Bremen are responsible for part of the German cigarette output. There are also a soap factory and several breweries. Three jute mills include one of the largest of its kind in Germany.

Oil storage is considerable (see p. 100), and there is a refinery (*Deutsche Vacuum Öl A.G.*) with an estimated annual capacity of 100,000 tons.

It is interesting to note that there are active industries in several satellite towns lying at some little distance from Bremen, owing to the comparative lateness of the entry of the city into the German customs area. Industries which worked primarily for the German market, even if called into being by Bremen enterprise, settled outside the city at such places as Hemelingen, Blumenthal and Delmenhorst. There is a large woollen mill at Delmenhorst and a wool-combing mill at Blumenthal (see p. 30). Delmenhorst is also the centre of a linoleum industry.

Communications

Rail. The quays are well served by rail tracks, connected both to the lines in the city and to a loop and sidings behind the basins. Double-track lines provide connexions from the city: north to Bremerhaven and Cuxhaven, north-west to Hamburg, east to Berlin, south to Hanover and south-west to Emden and Oldenburg.

Waterway. The canalization of the Weser as far as Minden so that it will admit 1,000-ton barges, will improve the waterway connexions of the port, enabling it to benefit from the construction of the Mittelland C., linking Minden on the Weser above Bremen with the Dortmund-Ems C. to the west and with the Elbe to the east (see p. 592).

Roads. See Fig. 17.

Cuxhaven (Fig. 18; Plate 11)

Cuxhaven lies at the entrance to the Elbe estuary on the left or southern shore, and is 56 sea miles below Hamburg. At this point the estuary is 11 miles wide. In normal times Cuxhaven is a port used by vessels in distress or waiting to proceed up the river to Hamburg, a quarantine station, a pilot and marine signalling station, and the headquarters of the Elbe buoyage service. It is one of the

largest fishing ports in Europe, and in time of war a base for small naval craft.

Approach and Access

The port lies 20 miles upstream from the Elbe I light-vessel, and the approach channel is maintained by dredging to take vessels drawing up to 36 ft. at flood tide. Silting is rapid in the fairway. From the open sea to Cuxhaven a series of sand banks borders the channel.

Strong easterly winds may reduce, and westerly winds increase the depths in the harbour by as much as 3 ft., but weather does not normally interfere with the working of the port. Ice conditions, even in hard winters, are rarely troublesome; although ice was experienced on 77 days during the exceptional winter of 1929, only sailing vessels were prevented from using the port. Over a period of ten years ice interferes with traffic on an average for one day a year and at a maximum for 12 days.

Spring rise	10·4 ft.
Neap rise	9·1 ft.
Mean level	5·1 ft.

Cuxhaven road offers anchorage in minimum depths of 30 ft. and is sheltered except from strong winds between north-west and north-east. When such winds are blowing, vessels unable to enter the port can anchor in Altenbruch road, about 2 miles upstream.

Detailed Description

The port provides the following accommodation:

Average length, ft.	Minimum depth, ft.	No. of berths
600	30	4
450	26	1
450	20	2
350	20	20
250	16	9
200	12	44

There are four main basins in the port; all are tidal, and may be entered at any state of the tide. Alter Hafen deals primarily with coastal traffic. Fischerei Hafen and Neuer Fischerei Hafen serve fishing vessels only. Amerika Hafen is still incomplete, and is intended to take large ocean-going ships. Details of the basins and other important berthing places are as follows:

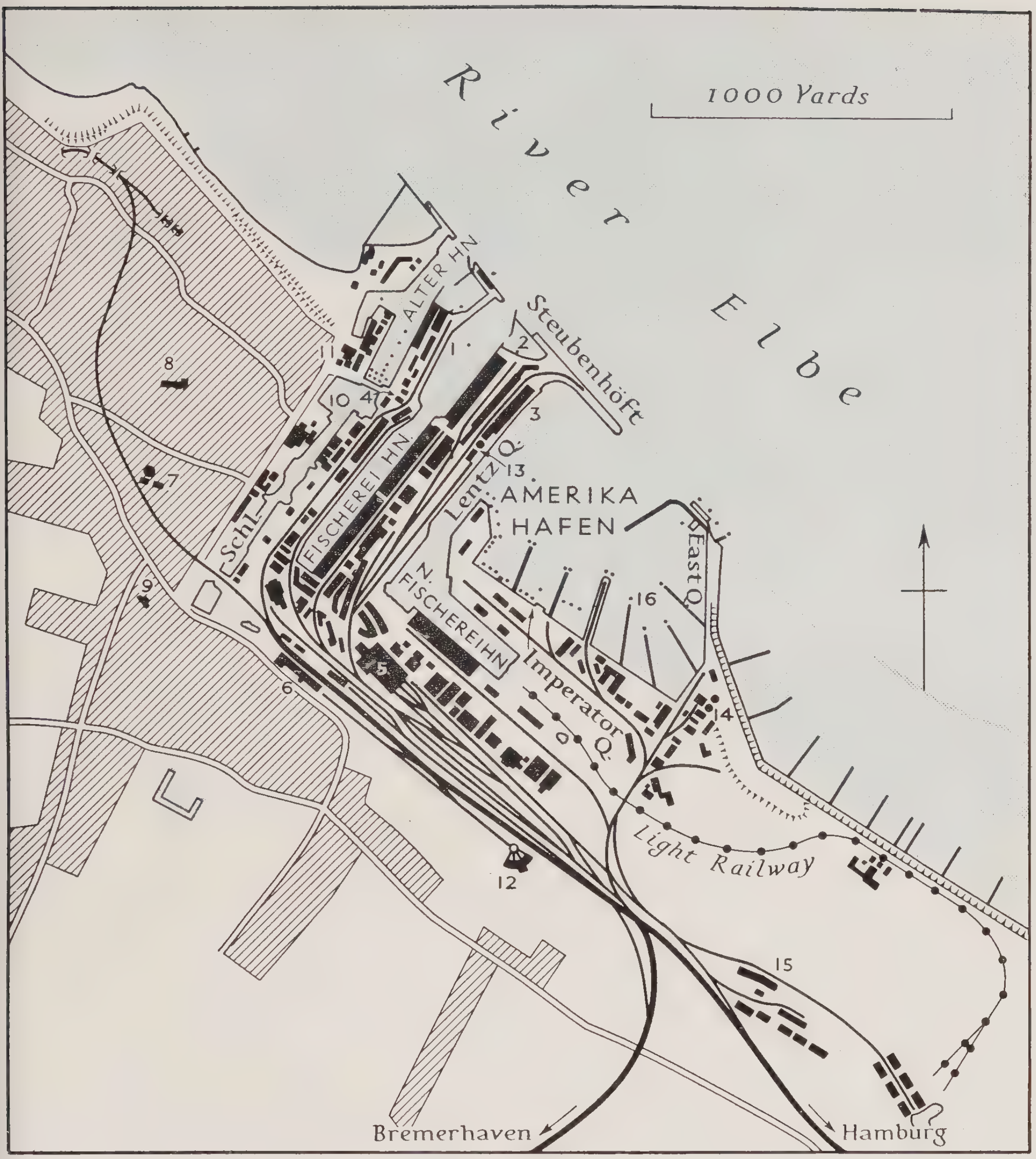

Fig. 18. Cuxhaven

Based on G.S.G.S. 4480, Cuxhaven.

Schl. Schleusenpriel; 1 Harbour station; 2 Fish market; 3 Passenger hall; 4 Customs; 5 Goods station; 6 Station; 7 Gasworks; 8 Town Hall; 9 Post Office; 10 Mutzefeldt shipyard; 11 Sanftleben shipyard; 12 Loco. shed; 13 Oil storage; 14 (?) Oil storage; 15 Groden mine depot; 16 Minelayer and minesweeper harbour.

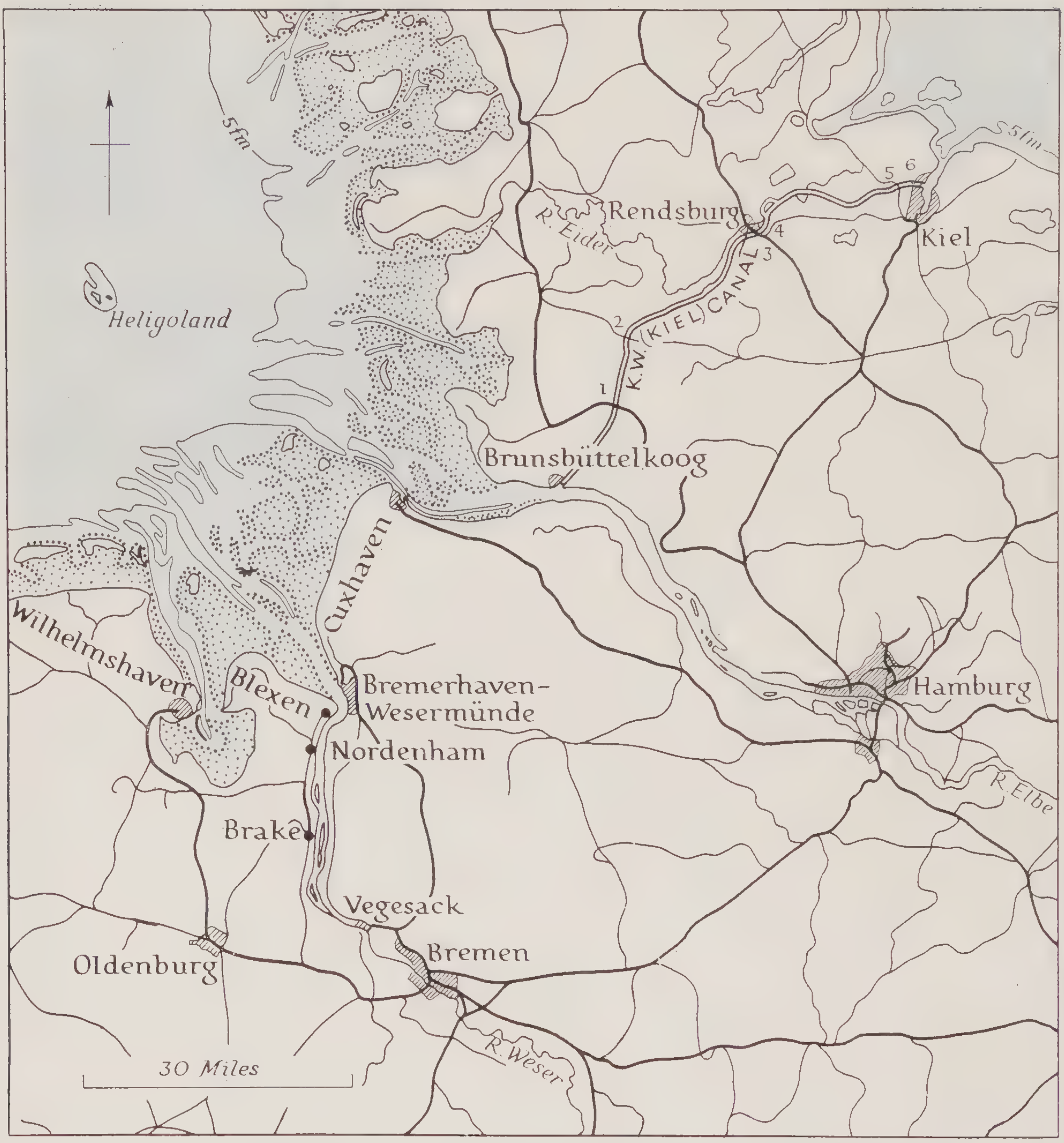

Fig. 19. Hamburg, Bremen and the Kiel (Kaiser Wilhelm) Canal

Based on G.S.G.S. series 4072, Europe (Air), 1 : 500,000, Sheet N.E. 52/6 (Lübeck special sheet).

Double-track railways are shown by a thick line and single-track railways by a thin line. Bridges: 1 Hochdonn (railway); 2 Grünenthal (road and railway); 3 Low-level swing (road and light railway); 4 Rendsburg high level (railway); 5 Levensau (road and railway); 6 Prinz Heinrich (road). Details of the railway bridges will be found on p. 300.

Basin	Quayage: Total length, ft.	Quayage: Depth below chart datum, ft.
Alter Hafen		
2 quays	1,170	15
East quay	975	13–15
Dolphins	600	13
Fischerei Hafen		
5 quays	6,370	20
Steubenhöft		
Main quay	1,260	42
Inner side	870	26
Amerika Hafen		
Lentz quay	1,730	30
Imperator quay		
5 jetties	2,760	20
East Quay		
5 jetties	1,165	20
Neuer Fischerei Hafen	3,735	17

The jetties in Amerika Hafen run out at right angles from the Imperator and East Quays, which are formed of sloping stone walls. Most of the quayage in Neuer Fischerei Hafen is not yet completed. The Steubenhöft is the main berth for large ships. There are eight small or medium cranes in the port.

Port Facilities

There are about 95,000 sq. yds. of warehouse space, sheds, etc., mainly in the fishing port. There are three small shipyards. One, at the north end of Schleusenpriel, has four hauling-up slips, the largest of which has a length of 492 ft. with a lifting power of 1,200 tons. In Ewer Hafen, on the west side of Alter Hafen, there are three slips, the longest of which is 230 ft. There is also a small slipway on the east side of Schleusenpriel.

The Town

Cuxhaven is a town of recent growth with a population of 26,000 in 1938. It lies mainly to the west of the port, on flat polder land. Electricity supplies are drawn from the grid, connecting with the power stations at Bremerhaven and Farge, and gas is derived from a municipally-owned works. The water-supply is provided by a group of nine wells situated probably $1\frac{3}{4}$ miles west-south-west.

Trade, Industry and Communications

Cuxhaven carries on very little trade.

	Total	Coastwise		Foreign	
		Outwards	Inwards	Outwards	Inwards
1936	35·1	12·1	10·6	0·7	11·8
1937	40·1	11·2	17·2	1·7	10·1

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

It had in former years some importance as a point where fast steamships plying between Hamburg and New York embarked and disembarked passengers, in order to avoid the slow journey up the river. Latterly, however, this traffic has declined and Cuxhaven has been replaced by Bremerhaven which has a superior rail connexion with Hamburg. Cuxhaven has grown considerably as a fishing port, and in Germany is second only to Wesermünde.

South-eastwards a double-track railway leads to Hamburg, and southwards a single-track line leads to Bremerhaven. For roads, see Fig. 17.

Hamburg (Figs. 19–28; Plates 12–19)

53° 12′ N., 10° 0′ E. Population: 1,682,000 (1939)

Hamburg is the largest port in Germany and ranks with Rotterdam, Antwerp and London as one of the four chief ports in Europe. It is the second largest city in Germany with a population of 1,682,000 in 1939. It represents, therefore, an urban agglomeration three times the size of Antwerp and nearly twice as large as Rotterdam. The support of the greater part of this considerable population is an extensive range of industries.

Approach and Access

From the Elbe I light-vessel the distance to Hamburg along the main channel is between 76 and 80 miles. The depth in the main fairway was maintained by dredging, and normally vessels drawing up to 36 ft. could reach the port on the flood tide.

In severe weather a great deal of ice, mainly brought down from higher up the Elbe, accumulates in the port. This ice may accumulate sufficiently to stop small vessels, but sea-going vessels are not hindered. The tidal range is not great:

	At mouth of the Elbe	At Hamburg
M.H.W.S.	10·8 ft.	8·15
M.L.W.S.	0·4	0·01
Mean level	4·28	4·26

Detailed Description

The city itself lies on the north bank of the river, but the arrangement of the entire port and urban area presents a certain complexity. The Elbe winds across a flat floodplain of alluvium, between low hills of sandy country (*geest*). Some distance above Hamburg it divides into two main branches, the Norder Elbe and Süder Elbe. The city lies on the north bank of the Norder Elbe where this stream flows close to the bluffs, giving a dry site near deep water. Farther downstream is Altona, formerly a separate town. Five miles southwards across the intervening floodplain, where the Süder Elbe swings close to the southern bluffs, Harburg occupies an analogous site, although this branch of the river has been less favourable for navigation. Part of the intervening floodplain is taken up by the factories and houses of Wilhelmsburg. Each of the urban centres formerly operated harbour facilities, but in 1937 they were amalgamated into the *Hansestadt Hamburg*.

The entire port is therefore now under one administration. All the harbours are tidal; the low range of tide obviates the need of wet-docks. A great deal of cargo is transhipped to barges alongside, for mooring at dolphins is a common practice. The berthing accommodation in the port may be summarized as follows:

Average length, ft.	Minimum depth, ft.	No. of berths
600	29	35
450	26	108
450	20	134
350	20	120
250	16	39
200	12	56

The port comprises some quays and basins on the north bank of the Norder Elbe, a large number directly across the river on the alluvial 'island', and several at Harburg on the south bank of the Süder Elbe. Running roughly from north to south is the Köhlbrand Channel, a branch of the Süder Elbe which gives access to Harburg for sea-going ships. Most of the basins are separated by broad intervening tracts which form, in effect, moles, and which carry warehouses, rail-tracks, factories and shipyards.

The combination of natural waterways, excavated basins and cuts has given much of Hamburg the character of a series of connected islands. Except for the river-front harbour of Altona, the St Pauli landing stage and Johannisbollwerk quay on the north bank of the Norder Elbe, the greater part of the port, i.e. the Hamburg free

zone, the western basins, Wilhelmsburg and Harburg are isolated by waterways. In the large complex of basins on the south bank of the Norder Elbe the basins are connected by waterways for barge traffic. The dividing moles are connected to the mainland by road or rail bridges. The three main bridges across the Norder Elbe —two rail and one road—are thus of primary importance. A tunnel was opened in 1911, connecting the north bank of the Norder Elbe, near the St Pauli landing-stage, with the south bank opposite.

The principal quays and basins may be described as follows, starting from Altona and working east along the north bank, then along the south bank, and concluding with Harburg.

Altona. Facilities here are formed mainly by quays lying behind a parallel detached mole.

	Depth, L.W. springs, ft.	Quayage, ft.	Quay cranes	Other gear
Westkai (1)	28–31	2,500	39	5 coal grabs
Fischereihafen (2)				
Kohlenkai	24–28	600		
Ostkai (3)	23–28	2,300		
Quayage to St Pauli L.S.	23	820		
Holzhafen (smaller craft)	17–27	30	1	2 coal bridges
Alter Fischereihafen	20½–22	750	3	

The figures in brackets refer to the numbers given to the quays, etc., in Fig. 20.

Hamburg: North Bank. The St Pauli Landing-stage (4), 1,475 ft. long, has 35 ft. of water at M.H.W.S., and the Überseebrücke, with 950 ft. of quayage, has 35–37 ft. The Johannisbollwerk, or Town Quay (5), is 1,100 ft. long, with 26 ft. at M.H.W.S.; it was equipped with eight quay cranes. The basins comprise the following: Sandtorhafen, Schiffbauerhafen, Grasbrookhafen, Strandhafen, Magdeburgerhafen, Baakenhafen, Kirchenpauerhafen. Schiffbauerhafen is actually a quay. (See first table on page 61.)

South of the Norder Elbe lie three main groups of basins, comprising the greater part of the port. In each of the first two series the basins radiate towards the east and south. The first and second series form the free port. Upstream the main north-south railway crossing forms a limit. The first series is bounded on the west by the Reihersteig, a canal. (See second table on page 61.)

Segelschiffhafen was used for handling general merchandise. Hansahafen also handled general merchandise, and was frequented by vessels of the Hamburg-Amerika line. At the southern end of

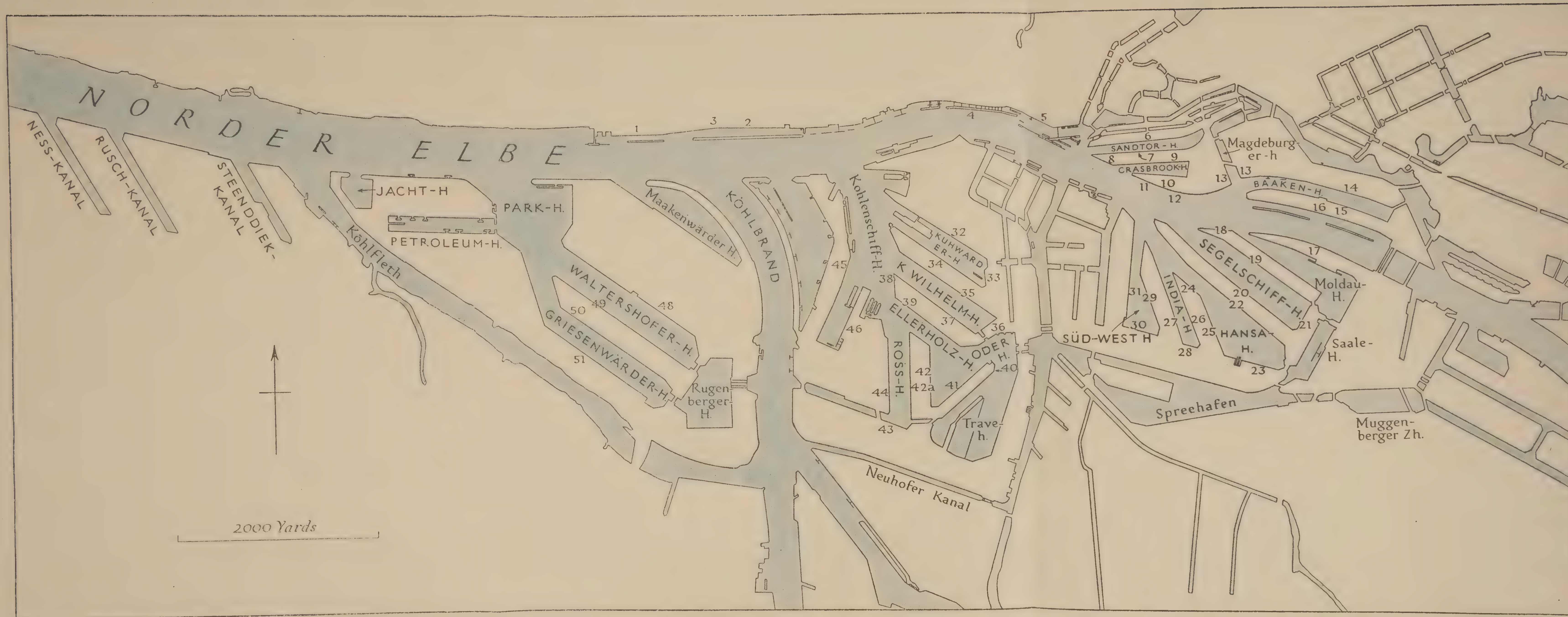

Fig. 20. Hamburg: basins and quays

Based on official sources.

The numbers correspond to the numbers given to the quays on pp. 61, 62, 63. Basins for sea-going ships are shown in block capitals, barge basins in lower case. See also Figs. 21, 28.

Basins and quays	Basin: dimensions in ft.				Berthage: dimensions in ft.			
	Date	Length	Breadth	Depth below chart datum	Length	Depth alongside H.W.S.	No. of quay cranes	Other cranes
Sandtorhafen	1866	3,400	350	16–20				
Sandtorufer (6)					3,350	23	63	
Kaiserkai (7)					2,900	23		
Schiffbauerhafen (8)	1882			16				
Kaiserhoft					590	23		1 30-ton
Dolphins					650	31		
Grasbrookhafen	1872	2,000	250–300	16–22				
Dalmannkai (9)					2,300	23	25	
Hubenerkai (10)					2,100	23	19	
Strandhafen (11)	1879			24				
Strandkai (12)					1,900	25–30	18	
Dolphins					3,850	25–30		
Magdeburgerhafen	1888	1,400	260	18				
Quays W. and E. side (13)					570	24–31	10	
Baakenhafen	1887	4,500	400–460	18–30				
Versmannkai (14)					4,025	25–36	80	
Petersenkai (15)					4,475	25–36	5	
Dolphins					3,000	25–36		
Kirchenpauerhafen	1891			16–26				
Kirchenpauer-kai (16)					4,100	23–33	39	1 30-ton
Dolphins					6,400	23–33		el. coal tip
Halthusenkai (17)					2,300	30	19	
Kranhöft (18)					690	30	1	
Segelschiffhafen	1888	4,450	525–880	21½				
Asiakai (19)					4,500	28½–30	38	1 30-ton
Amerikakai (20)					4,800	28½–30	14	
Amsinckkai					770	28½–30	44	
Dolphins					12,800	28½–30		
Hansahafen	1893	5,300	400–1,300	23				
O'Swaldkai (22)					5,300	29–30	84	1 30-ton
Lübecker Ufer (23)*								
Hansahoft (24)					920	29–30		
Bremerkai (25)					1,880	29–30	3	
Dolphins					10,800	29–30		
Indiahafen	1893	2,400	400–500	18–23				
Australiakai (26)					2,150	26–30	35	
Kamerunkai (27)					3,130	29–30		
Indiakai (28)					400	29–30	24	
Dolphins					2,600	29–30		
Südwesthafen	1876	3,000	300–725	26				
Afrikakai (31)					1,550	33		
Windhukkai (30)					1,100	33	24	
Togokai (29)					2,590	33	13	
Dolphins					1,900	33		
Kleiner Grasbrook								

* Sloping wall.

The figures in brackets refer to the numbers given to the quays, etc., in Fig. 20.

Indiahafen there are extensive coke-ovens (*Norddeutsche Kohlen- und Cokeswerke*). Südwesthafen dealt principally with general merchandise.

These basins are backed by a number of barge basins. *Moldauhafen* has direct access from the Norder Elbe and leads into the small *Saalehafen* which in turn leads into the extensive *Spreehafen*. Between these two latter basins is a fixed railway bridge carrying a

Basins and quays	Basin: dimensions in ft.				Berthage: dimensions in ft.			
	Date	Length	Breadth	Depth below chart datum	Length	Depth alongside H.W.S.	No. of quay cranes	Other cranes
Kühwarderhafen	1902	3,300	750	22–33				
Steinwarder-ufer (32)					3,300	30–40		1 250-ton
Mittelufer (33)					410	30–40	30	3 gr. el.
Greven-hofufer (34)					3,330	30–40	2	
Dolphins					1,500	30–40		
Kaiser Wilhelmhafen	1903	3,650	700	25–33				
Auguste Viktoriakai (35)					4,200	32–40	6	1 65-ton
Reiherkai (36)					540	32–40	88	
Kronprinzkai (37)					3,000	32–40	4	
Dolphins					4,600	32–40		
Ellerholzhafen	1903	2,500	600	23–30				
Ellerholzhoft (38)					540	30–37	1	
Möncke-bergerkai (39)					—	—	20	
Dolphins					3,400	30–37		
Oderhafen	1903	2,150		28–30				
Oderhöft (40)					656	35–37	14	
Chilekai (42)					1,900	40	24	
Sthamerkai (41)					2,150	40	13	
Rosshafen	1908	2,800	750	23–33				
Rosskai (42a)					2,400	30–40	6	
Neuhoferkai (43)					795	36½–40	5	
Hachmannkai (44)					2,740	36½–40	2	1 40-ton
Dolphins					4,600	36½–40		
Vorhafen								
Fitting-out berths (45)					1,720	25–27		
Dolphins					1,300	36½–40		
Vulkanhafen		2,100	650	11–28				
Vulkankai (46)					1,600	20–40		1 200-ton, etc.
Kohlenschiffhafen	1903	4,200	1,310–260	10–24				
Coal discharging quay (47)					1,640	27		
Dolphins					11,060			
Grenzkanal					3,500	27	10	
Reiherstieg					4,000	23–26		

The figures in brackets refer to the numbers given to the quays, etc., in Fig. 20.

very large traffic, as it forms the principal connexion between the tracks of the free port and the main railway system. A canal from *Spreehafen* leads eastwards to *Muggenburger Zollhafen*, from which two canals lead eastwards.

To the west of this group of basins across the *Reiherstieg C.* lies the next group of south bank basins, still forming part of the free port. (See table on page 62.)

Kohlenschiffhafen is a barge basin. Behind the inner edge of this group lies *Travehafen*, a large barge basin.

West of the Köhlbrand Channel lie the basins of the Customs Zone. These are of fairly recent construction, and several are unfinished. In general they take up a direction parallel to the Norder

Basins and quays	Basin: dimensions in ft.				Berthage: dimensions in ft.	
	Date	Length	Breadth	Depth below chart datum	Length	Depth alongside H.W.S.
Customs zone:						
Maakenwärderhafen	1924	4,100	830–1,000	16*		
Dolphins					5,600	23
Parkhafen, not completed				27–34		
Dolphins					1,300	34
Waltershoferhafen	1915	5,000	990	28		
Burchardkai (48)					2,050	25–40
Predöhlkai (49)					1,160	35–40
Dolphins					11,000	35–40
Griesenwärderhafen, not completed		3,900	660	23½		
Stoltenkai (50)					750	30½
Diestelkai (51)					3,630	30½
Dolphins					940	30½
Petroleumhafen	1913	3,300	560	31		
Dolphins					3,300	29½–39
Bubender and Parkhoft-Ufer quay					4,000	25–32
Jachthafen					984	22½
Köhlfleth				13½		
Piers and dolphins					4,455	17
Steendiekkanal		2,800	385–280			
W. side Deutsche Werft fitting-out berth					1,900	25–30
Ruschkanal, being dredged						
Nesskanal, being dredged						

The figures in brackets refer to the numbers given to the quays, etc., in Fig. 20.

* Much is shallower.

Elbe. Mäkenwarderhafen is used for barge traffic. Adjacent to it lies a broad strip of ground which is the site of a projected basin —Mühlenwarderhafen. The south-eastern ends of Waltershoferhafen and Griesenwärderhafen lead into the Rugenbergerhafen, a barge basin which is connected with the Köhlbrand by means of twin locks.

Harburg-Wilhelmsburg. This section of the port comprises the newer Seehäfen, together with the old basins of Verkehrshafen, etc., entered by locks, and used mainly by coasters and inland waterways craft. The sill depths of these locks are $17\frac{1}{2}$ ft. and $14\frac{1}{2}$ ft.

Basins and quays	Basin: dimensions in ft.			Berthage: dimensions in ft.			
	Length	Breadth	Depth below chart datum	Length	Depth alongside H.W.S.	No. of quay cranes	Other cranes
Harburg-Wilhelmsburg:							
Seehafen I	1,800	300–650		2,165	31	17	
Dolphins				1,400	31		
Seehafen II	2,000	430	$26\frac{1}{2}$	2,140	31	8	3 bridge cr. 1 coal tip
Dolphins				2,050	31		
Seehafen III	2,300	420	$26\frac{1}{2}$	950	31	6	2 bridge cr.
Dolphins				2,450	31		
Seehafen IV (*Petroleumhafen*)	3,250	460	28	6,000	33	1	1 bridge cr.
Verkehrshafen				2,500	20	7	
Uberwinterungshafen				2,300	$17\frac{1}{2}$	10	
Lothsekanal				656	$19\frac{1}{2}$	7	
Ziegenwiesenkanal				2,000	$19\frac{1}{2}$	6	
Hafenkanal				1,710	$19\frac{1}{2}$	16	1 bridge cr.
Ostlicher Bahnhofskanal				2,080	13	16	
Westlicher Bahnhofskanal				2,133	13	8	Elevator plants

The Free Port. The free port comprises most of the basins in Hamburg, especially between the Elbe bridges and the Köhlbrand, as well as the greater part of the Waltershof installations. The entire zone is bounded by a fence on land and a type of boom on water surfaces. Vessels bound for the free port enter without being subject to customs dues, and goods may be unloaded without payment of dues. Within the free port also, raw materials may undergo semi-fabrication outside customs jurisdiction. There are over 150 industrial enterprises, employing altogether more than 25,000 workers.

The facilities of the free port have permitted Hamburg to develop

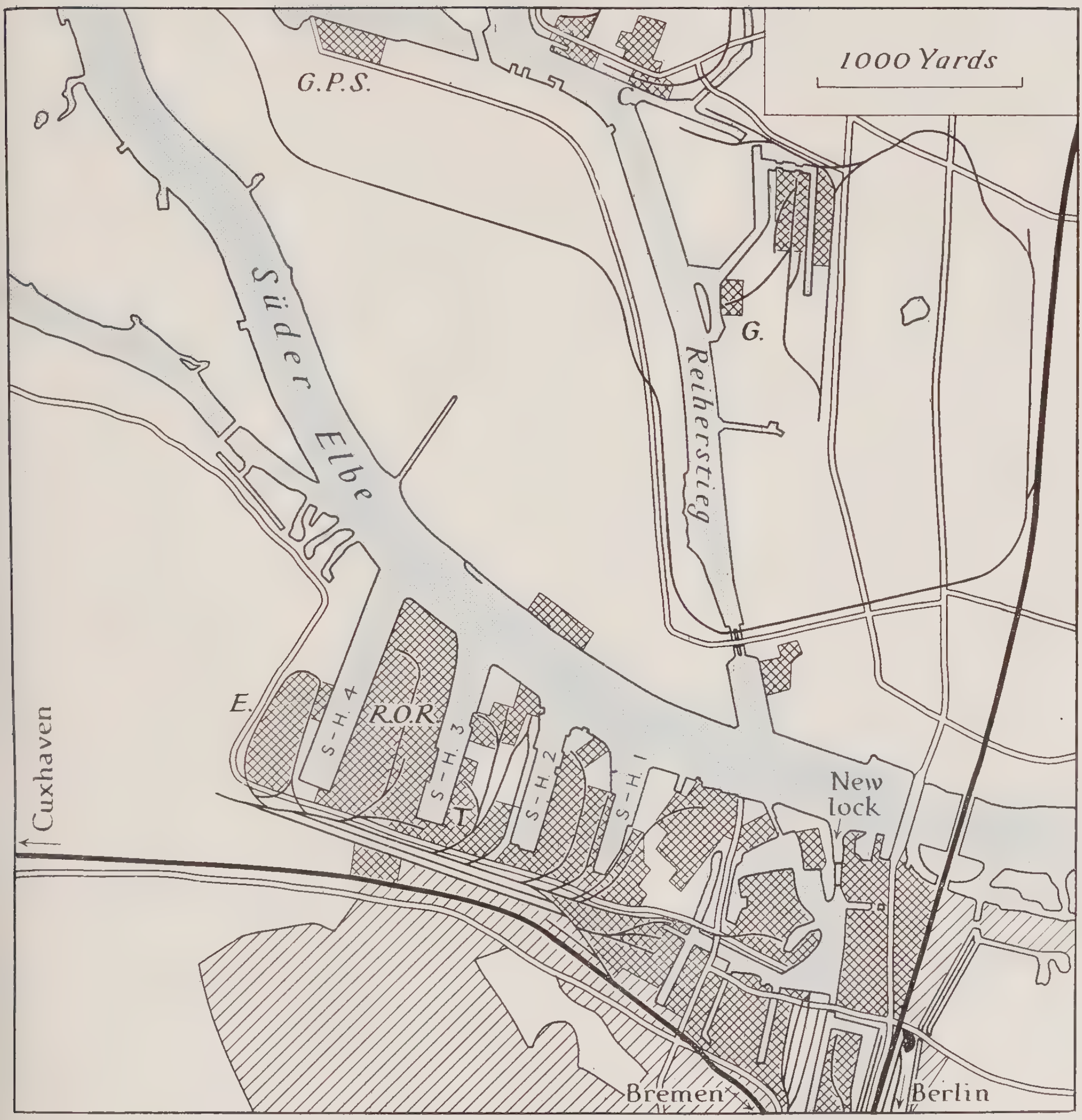

Fig. 21. Harburg

Based on official sources.

C. Chemical works; E. *Ebano Asphalt Werke*; G. Grain mill; G.P.S. German Potash Syndicate; R.O.R. *Rhenania Ossag refinery*; T *Thorl* oil works. The cross-hatching indicates port and industrial installations.

as a transit centre and have encouraged refining and semi-fabricating industries to settle there. Part of the free port is a Czechoslovak free zone, created under articles 363 and 364 of the Treaty of Versailles. By these articles Czechoslovakia obtained a lease for 99 years of a section of the free zone at Hamburg. A similar concession was secured at Stettin.

Port Facilities

The port was well equipped with warehouses; state-built quay sheds in the main port area number 86, while there are numerous warehouses used only for barge traffic. Covered space totals nearly 160 acres.

There is only one dry dock at Hamburg, reported to have come into use in 1943. It lies close to the Blohm and Voss shipyard and has an inside length of 1,056 ft. This firm owned seven floating docks, of which the largest measured 625 ft. *Howaldtswerke A.G.* yard owned four floating docks, of which the longest was 605 ft., while the *Deutsche Werft* owned five, up to 508 ft. Two other yards possessed five smaller floating docks. The total in the port was therefore twenty-one. Slips owned by the shipyards were as follows:

Blohm and Voss	9 slips, longest 900 ft.
Howaldtswerke A.G.	3 slips, all 640 ft.
Deutsche Werft:	
Finkenwärder	3 double slips, all 600 ft.
Reiherstieg	2 double slips, longest 500 ft.
H. C. Stülcken Sohn	3 slips, longest 300 ft.
Norder Werft	5 slips, longest 250 ft., one broadside; (two patent slips).
Eight other medium shipyards	Mostly patent broadside slips.

Shipyards of Hamburg. The concentration of shipbuilding at Hamburg makes it the most important centre in continental Europe. Three yards—*Blohm und Voss*, *Howaldtswerke A.G.*, and *Deutsche Werft* (Finkenwärder yard)—account for the bulk of the output. *Blohm und Voss* own the largest private yard in Germany. Its normal output includes merchant vessels of the largest types, such as the *Europa* (49,700 tons), and naval vessels up to the size of the pocket-battleship class. The yard also constructs M.A.N. diesel-engines, not only for marine purposes, but engines up to 15,000 h.p. for industrial purposes. *Howaldtswerke A.G.*, now reported to be controlled by the *Deutsche Werft* company, operate a yard sometimes known as Vulkanwerft. Normally the yard builds merchant ships

up to 8–9,000 tons gross; the construction of the diesel-electric liner *Robert Ley* (27,000 tons gross) was an exceptional operation. The yard is said to be particularly concerned with the development of ships' machinery and engines. About 45 acres of the site are occupied by the principal M.A.N. diesel-engine works in Hamburg. The Finkenwärder yard of the *Deutsche Werft* normally constructs vessels up to 10,000 tons, but had also built cargo and tanker vessels up to 16,000 tons. Most of the ships built in this yard were engined with Burmeister and Wain diesel-engines brought from the A.E.G. works at Berlin. The Reiherstieg yard of this company builds merchant vessels up to 7,000 tons as a rule, although some ships reached 10,000 tons. *H.C. Stülcken Sohn*, while sometimes building vessels of 2,000 tons gross, normally constructed small craft; *Norder Werft* also built mainly small ships. Smaller yards number about 50; some of these in normal times have a considerable output of barges.

The shipbuilding industry as a whole is served by an important research institute, the *Schiffsbauversuchs-Anstalt*, situated in Barmbeck, to the north of the city.

Hamburg has suffered severe damage in air attacks. Large areas of the town, particularly round the Binnen Alster and in St Pauli, have been devastated. The dock area has likewise suffered, many warehouses having been destroyed and over 50% of the floating docks damaged beyond repair.

The City

The 'Hansa City' of Greater Hamburg is a Federal State of the Reich with an area of 747 sq. km. (270 sq. miles) and a population of 1,682,220 (1939). It is the second city in the Reich.

After some twenty years of negotiations between Hamburg and Prussia concerning the amalgamation of the chief ports on the lower Elbe, Greater Hamburg was at last established as a compact political and economic unit by a law of 26 January 1937. There was an exchange of territories between Hamburg and Prussia. Hamburg absorbed the neighbouring ports of Altona and Harburg-Wilhelmsburg—Harburg and Wilhelmsburg having been united in 1927—as well as the suburb of Wandsbek and 27 adjacent districts. On the other hand, various scattered outlying Hamburg districts were transferred to Prussia, the most important being the district of Ritzebüttel, which includes the outport of Cuxhaven (pop. 28,700 in 1938) at the mouth of the Elbe.

Until 1937 the three ports of Hamburg, Altona and Harburg-

Fig. 22. The site of Hamburg

Based on G.S.G.S. Series 4416, 1 : 100,000, Sheet L4.

Most of the land below 10 m. altitude comprises *marsch*, i.e. low ground which would be flooded by the river and by high tides except for the extensive dyking carried out in early centuries. Most of the land above 10 m. is *geest*, an undulating surface of sands providing dry sites for building.

Wilhelmsburg, which now form Greater Hamburg, were rivals and each had developed on its own lines.

Hamburg. The first settlement at Hamburg was on the site now occupied by St Peter's Church (the *Petrikirche*) and the Cathedral. Various factors influenced the choice of this site. First, it was a spit of dry land (an extension of the *geest*) in the midst of marshy country. Secondly, from the point of view of commerce and transport, it guarded a trade route over the lower Elbe. The existence of several islands in the river facilitated its crossing at this point. Thirdly, the site was comparatively safe from hostile attack since it was situated between the rivers Elbe, Alster and Bille.

By 1150 the built-up area had reached a canal which crossed the *Brandstwiete* and can still be identified. Between 1187 and 1200 a new town was built on the right bank of the Alster—the district now known as the *Nickolaikirchspiel.* It had its own walls, market, and town hall and its administration was independent of that of the old town.

In the thirteenth century the old town was extended on the one side towards the Elbe (the *Katharinenspiel*) and on the other hand north-east in the direction of the modern main railway station (the district round the *Jakobikirche*). The development of the low-lying *Katharinenspiel* district was made possible by artificially raising the level of the ground. The soil for this purpose was obtained by excavating a number of narrow channels between Hamburg and the Elbe. These channels—called *Fleete*—were useful from the point of view of trade. Warehouses were built along the *Fleete* : the small ships of medieval times could reach them from the Elbe. Many of these buildings survive and they are a characteristic feature of part of old Hamburg. By this time ships docked not only at the junction of the Elbe and the Alster but also at the Bille. It was in the thirteenth century, too, that the river Alster was dammed up and the lake of the Alster basin was artificially created. In this way water-power for mills was provided and a new barrier against hostile attack was erected.

Early in the thirteenth century (1216) the two Hamburgs were united in a single administrative unit, while in c. 1250 the old town and its thirteenth-century extensions as well as the new town were —to a great extent—enclosed within a single system of fortifications. On a modern street plan the walls built at that time may be traced by following the *Zollkanal* (in the south), the *Admiralitätsstrasse* and the *Neuer Wall Strasse* (in the west) and two gates in the north-

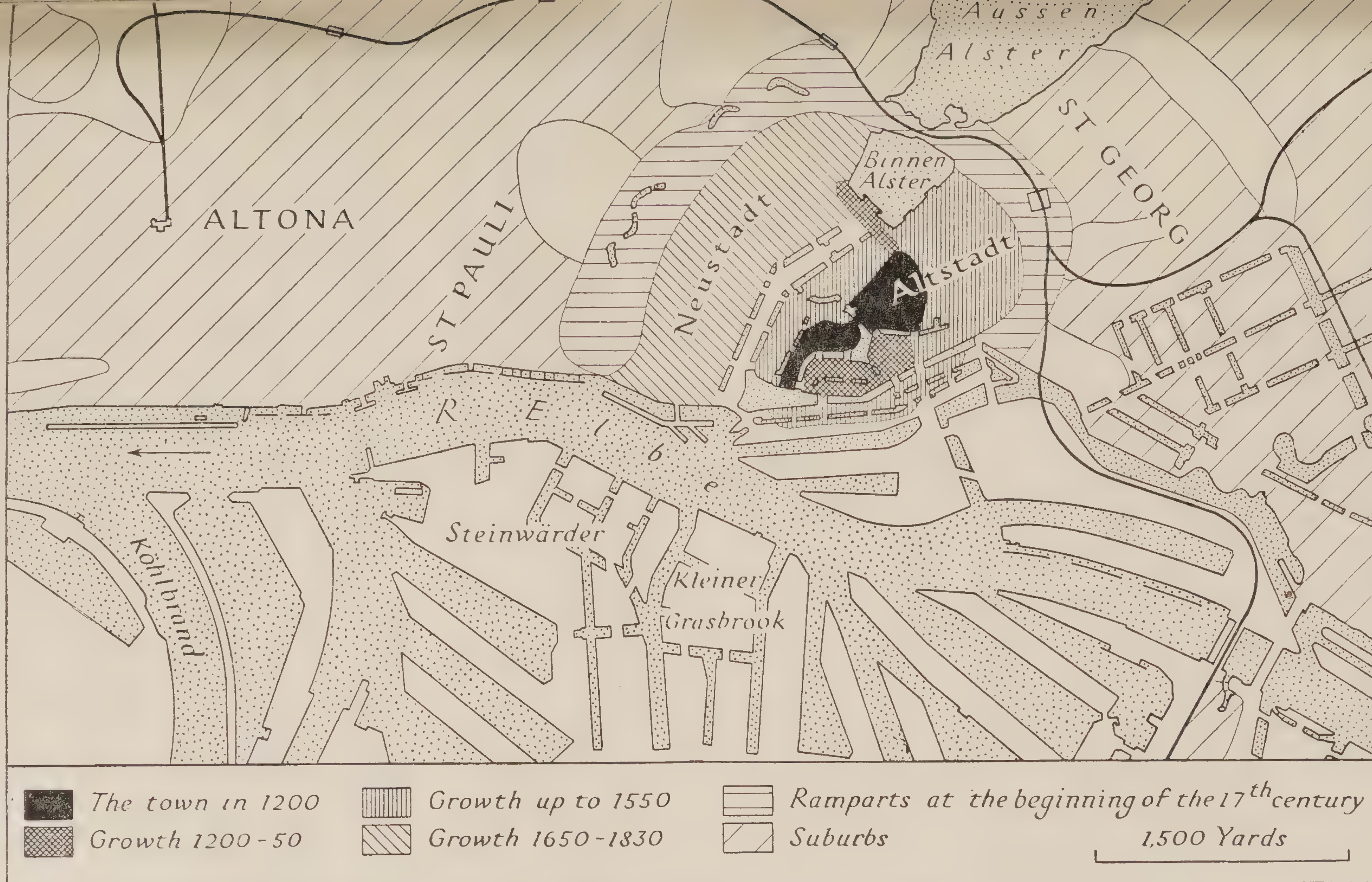

Fig. 23. The growth of Hamburg

Based on G. Braun, *Deutschland*, p. 69 (Berlin, 1936).

The river Alster originally reached the Elbe by a course now marked by the parallel lines of small rectangular bodies of water. The early city, up to 1550 therefore, was quite separate from Altona. The map does not show any of the stages in the growth of Altona.

east (the *Klostertor* and the *Steintor*). The ancient *Zollkanal* was extended to the river Bille in 1258 and it linked up-river traffic with the lower Alster where sea-going ships were accommodated. In the fifteenth century the original docks on the Alster and Bille were turned into an Inner Harbour by the construction of the 'lower boom' (*Niederbaum*). The modern Lower Boom Bridge (*Niederbaumbrücke*) marks approximately the site of this old floating boom which closed the harbour entrance after traffic hours.

In 1530 the walls of the town were strengthened and extended somewhat to the south in the direction of the modern Sandtor Harbour and Brooktor Quay. At the same time a wall was built between the Rödingsmarkt and the Jungfernstieg where there had formerly been no fortifications.

The extension of urban settlement beyond the walls—e.g. the St Pauli and St Georg districts—made it necessary for new fortifications to be built early in the seventeenth century. They were constructed under the supervision of a Dutch engineer (Captain Van Valchenburgh). The walls of 1616–26 enclosed an area twice as large as that of the medieval town. At the same time the artificial Alster lake was divided by a dam into the Outer and Inner Alster. (These seventeenth-century fortifications were dismantled early in the nineteenth century and the land thus cleared was used partly for promenades and partly for the building of railways. The centre of the town—the *Nikolaispiel* and the *Petrikirche* district—where most of the houses were still built of wood, was to a great extent destroyed by fire in 1842 and was subsequently rebuilt. The cholera epidemic of 1892 led to a thorough reform of the city's system of drainage.)

By the Treaty of Gottorp with Denmark (1768) Hamburg bought important new territories on the Elbe islands south of the port and also on the opposite bank of the river. These districts were: Kaltehofe, Pente, Müggenburg, Veddel, Schuhmacherwärder, Steinwärder, Grevenhof, Kuhwärder, Ellerholz, Maakenwärder, Mühlenwärder, Griesenwärder, Park, Pagensand, Flethsand, Dradenau and part of Finkenwärder.

Towards the end of the eighteenth century the old open roadstead (the *Niederhafen*) beyond the Inner Harbour was enclosed by floating booms. Ships using the *Niederhafen* discharged their cargoes by small lighters (*Prähme*). It was not until 1862–6 that the Sandtor Harbour—Hamburg's first modern basin—was built on Grasbrook Island. On the river bank facing this island the Kaiser Quay was

built in 1869–72 and at the same time a second harbour basin on Grasbrook was completed. The Petroleum (now the South-West) Harbour dates from the same period. The St Pauli landing-stages came next and then—in the eighties—there followed the construction of the huge Free Port system of basins.

The extension of Hamburg in the nineteenth and twentieth centuries was mainly along the Alster and to the north-east. Barmbeck, Eppendorf, Winterhude, Ohlsdorf, Fuhlsbüttel and—across the Prussian frontier in those days—Wandsbek all developed as residential suburbs. Eppendorf has a famous hospital, while Ohlsdorf possesses the largest cemetery on the Continent. Elmsbüttel, Hamburg's most westerly suburb until 1937, was originally a garden city, but most of the small houses have now disappeared and large blocks of flats have replaced them. Wandsbek—which absorbed the districts of Hinschenfelde and Marienthal—though largely residential in character has an industrial quarter in the south-east. Here cocoa, cigarettes, leather and chemicals are manufactured. Meanwhile the centre of Hamburg was ceasing to be a residential district and was becoming almost wholly devoted to business. The population of the central districts sank from 170,000 in 1880 to 85,000 in 1926.

Highly developed passenger and transport services were developed in Hamburg since the urban area was restricted by arbitrary political frontiers and the city wished to house within its own boundaries as many as possible of those who worked there. The construction of the Elbe Tunnel, the Elevated Railway, the Walddörfer Railway and the establishment of a service of fast passenger vessels on the Alster lakes and in the harbour area were attempts to solve some of the problems created by the overflow of population into neighbouring Prussian districts (such as Wandsbek). These attempts were not wholly successful since the residential areas outside the city limits continued to grow.

Altona. In the middle ages the village of Herwardshude stood on the site of modern Altona. It was completely destroyed by fire in 1308. A new village grew up round a little fish market towards the end of the sixteenth century. It fell to (Danish) Holstein in 1640, and King Frederick III of Denmark raised Altona to the status of a town in 1664 and established there the first free harbour in northern Europe. He hoped that Altona would rival Hamburg as the chief port on the lower Elbe. During the Northern War the Swedish General Stenbok burned down most of Altona (1713). It was rebuilt shortly afterwards and surrounded by walls. Some of the eighteenth-

century buildings survive, e.g. the old Town Hall of 1716, the Catholic *Josephkirche* of 1718 and the Protestant *Hauptkirche* of 1742.

Altona gradually recovered from the effects of the fire and it was the port used by the (second) Danish East India Company. Napoleon's Continental System was a serious blow to its prosperity. In the nineteenth century Altona again made progress, but in 1853 the town lost its customs privileges and its trade declined. In the Danish War of 1864 Altona was occupied by troops representing the *Bund* and two years later the port—with the rest of Schleswig-Holstein—fell to Prussia. But it remained outside the Prussian customs systems until 1888, when both Hamburg and Altona were incorporated in the customs system of the united Reich.

Altona grew rapidly after 1870. Ottensen was absorbed in 1889; Bahrenfeld, Othmarschen and Övelgonne in 1890 and a number of other suburbs in 1927. The population grew as follows:

1803	23,000	1885	105,000	1905	168,000
1864	53,000	1890	143,250	1910	172,000
1871	74,000	1895	149,000	1925	183,000
1880	91,000	1900	161,500		

In the nineteenth century Altona was the largest town in Schleswig-Holstein, but since 1906 its population has been exceeded by that of Kiel.

The port played an important part in handling the trade of the lower Elbe. In 1926 its harbours were used by 1,536 sea-going vessels (595,477 tons) and 2,693 ships plying on the inland waterways (624,517 tons). Overseas imports in 1926 amounted to 849,240 tons and exports to 572,870 tons. Incoming inland traffic amounted to 514,570 tons and outgoing inland traffic amounted to 247,267 tons.

Harburg-Wilhelmsburg. Harburg lies opposite Hamburg on the left bank of the Süder Elbe which is linked with the main branch of the river (the Norder Elbe) by the Köhlbrand. Harburg is situated 10 m. above mean sea level at the foot of the wooded *Schwarze Berge* which form the northern end of the *geest* of the Lüneburg Heath. In the early middle ages Harburg lay in the territories of the Archbishop of Bremen. It gained municipal rights in 1300 and shortly afterwards (1376) was absorbed by the principality of Celle-Lüneburg. Between 1527 and 1642 it was the seat of a branch of the House of Guelph. Harburg was joined to Hanover in 1705 and fell to Prussia in 1866. Until its incorporation into Greater Hamburg it lay in the *Regierungsbezirk* Lüneburg in the Prussian province of Hanover. Commerce and industries developed in the nineteenth

Plate 9. Bremen: Freihafen, looking north-west
In the centre is Übersee Hafen, to the right Holz und Fabriken Hafen, to the left the Weser.

Plate 10. Bremen: the Altstadt (1936), looking east
In the foreground is the Kaiserbrücke. The cathedral is the church with twin spires.

Plate 11. Cuxhaven, looking west
The *Hamburg-Amerika* liner is alongside the Steubenhoft.

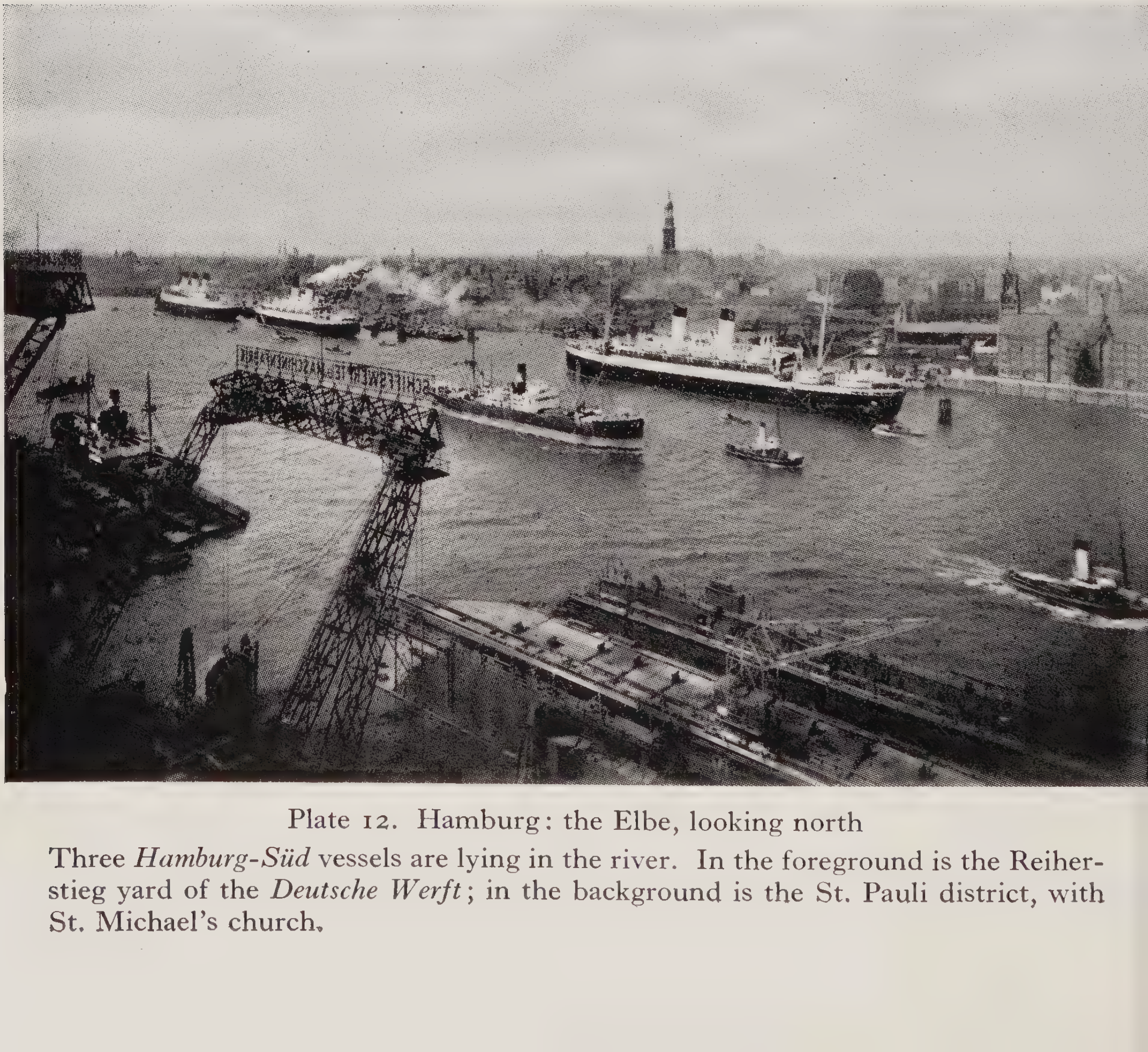

Plate 12. Hamburg: the Elbe, looking north
Three *Hamburg-Süd* vessels are lying in the river. In the foreground is the Reiherstieg yard of the *Deutsche Werft*; in the background is the St. Pauli district, with St. Michael's church.

century, particularly after direct railway communication was established with Hamburg, Bremen and Hanover. The population rose from 3,000 in 1850 to 72,000 in 1925. Wilhelmsburg (population 32,500), lying on the large alluvial island between Hamburg and Harburg, was absorbed in 1927.

The urban districts on the two sides of the Elbe are linked by three bridges—the old Railway Bridge (1868–72 and 1889–90), the Elbe Bridge (1868–72) and the Free Harbour Bridge (1926)—by the famous Elbe Tunnel between St Pauli and Steinwärder (completed in 1911 at a cost of £535,000), by passenger ferries, and by the Köhlbrand train ferry.

There are a number of bridges—some fixed and some movable—between the mainland and the islands in the Elbe, between the islands, and across the harbours. There are ten movable bridges—the double-storey four-track road and railway bridge across the *Oberhafen* (1902–5); the double-track railway bridge across the *Oberhafen* C. (1901); the Billhörner road bridge over the upper end of the *Oberhafen* C. (1886); the Ericus swing bridge from the Ericus-Graben to Brooktor Quay; the Meyerstrasse swing bridge from Brooktor Quay to the Magdeburg Harbour; the Braken bridge over the Magdeburg Harbour; two bridges over the *Reiherstieg* (1890 and 1906); the single-track railway bridge over the rear entrance to the Segelschiffhafen (1875–6); and an obsolete bridge across the entrance to the *Fährkanal*.

History

In A.D. 804 a castle, known as the Hammaburg, commanding a ford over the Alster on an important trade route to the north, was captured by the Emperor Charles the Great and incorporated in the Frankish dominions. In 831 Ansgar was appointed by Louis the Pious to be the first Archbishop of Hamburg. The commercial interests of the small settlement that developed round the castle were confined to trade with districts to the north and east. Maritime trade with the hinterland was controlled by Bardowik, higher up the Elbe valley near Lüneburg, and Stade, lower down the estuary.

The early history of Hamburg was a troubled one. It was a trading and missionary outpost on a frontier against the heathen: it was ravaged by the Normans (845 and 880), by the Slavs and Wends (983 and 1012) and by the Obotrites (1037 and 1072). The first destruction of the settlement by the Normans led to the transfer of the administration of the Archbishopric to Bremen.

At this time Hamburg was part of the dominions of the Dukes of Saxony. Early in the twelfth century Count Adolf III of Schauenburg secured Holstein, Stormarn and Hamburg as fiefs subordinate to Saxony. He was famous for his colonising and missionary activities in the lake country between Kiel and Lübeck which had been laid waste by the Obotrites. To promote the trade of his new settlement at Lübeck with the North Sea he founded the 'new town' of Hamburg and secured for it a charter from the Emperor Frederick Barbarossa. By this charter (1189) Hamburg was exempted from the payment of dues on the lower Elbe and the town had the duty of regulating the course of the river for the purpose of shipping. That duty Hamburg performed until 1921. A few months after Hamburg secured its charter its rival Bardowik was destroyed by Henry the Lion. Many Bardowik merchants settled in Hamburg which profited considerably from the misfortunes of its rival.

Hamburg's growth as a trading centre excited the enmity of Denmark. In the first quarter of the thirteenth century the two Hamburgs fell under the control of Waldemar of Denmark. Holstein and Lübeck defeated Denmark at the battle of Bornhöved (1227), however, and this victory enabled the Hamburgers to regain their freedom. In the fourteenth and fifteenth centuries Hamburg made rapid commercial progress as a leading member of the powerful Hanseatic League. Her ships sailed regularly to England, Flanders and Scandinavia as well as farther afield to France, Spain and even to Iceland, while her ships were carriers for other nations. She exercised strictly her monopoly of entrepôt trade on the lower Elbe. The whole grain trade of the district was in her hands. In 1400 her export trade was valued at £150,000 (modern currency). Industries, too, began to develop, and the city became famous for its beer. It is estimated that Hamburg's population rose from 7,000 in the early fourteenth century to 10,000 in the fifteenth and 12,000 in the early sixteenth century. Jews exiled from Spain and Portugal were admitted to Hamburg in the fifteenth century. The port had long secured a position of virtual political independence. This was formally recognized in 1510 when Hamburg became a Free City of the Empire.

In the sixteenth century the influence of the Hanseatic League declined. While the governments of the new national states that were rising in Europe gave full support to their merchants the Emperor was in no position to give effective help to the Hansards. The religious strife of the period of the Reformation and the political

disintegration of Germany contributed to the fall of the Hanseatic League. (The Reformation was introduced into Hamburg by Luther's friend Johann Bugenhagen in 1528–9.) The commercial relations between Hamburg and England in the sixteenth century illustrate the altered fortunes of the once-powerful Hanseatic League. Whereas in the century before the Hansa merchants held important trading privileges in England and had their own 'factory' (the Steelyard) in London, in Elizabeth's reign they lost most of those privileges and the English Merchant Adventurers moved their main continental 'staple' from Antwerp to Hamburg and secured a privileged trading position in the city. The 'factory' of the Merchant Adventurers was permanently established in Hamburg in 1611 and it was not abolished until the French occupation of the port in Napoleon's day.

The extension of world trade in the sixteenth century to new regions such as the Indies and the Americas led to an expansion of shipping traffic in the North Sea and the Atlantic and to a decline in the importance of the Baltic. Ports such as Lübeck and Danzig, which had once far outdistanced Hamburg, now lost their former paramount position, while the trade of Hamburg, on the other hand, increased, and even in the sixteenth century it was referred to as *florentissimum emporium totius germaniae.*

In the seventeenth century Hamburg did not suffer seriously from the effects of the Thirty Years War, which ruined so many once-prosperous German cities. Indeed, Hamburg derived some benefits from the arrival of refugees from other parts of Germany. And not only Germans but Dutchmen, Englishmen and Portuguese Jews settled there at that time. The new powerful fortifications of the town were a valuable protection against attack. More important, however, was the support Hamburg received from the great maritime Powers—Sweden, Holland and England—who were interested in the trade of the Elbe region. This support more than compensated for the lack of any help from the rapidly disintegrating Hanseatic League.

The chief danger to Hamburg at this time came from her old enemy Denmark. The Danes tried to gain control of the lower Elbe by founding Glückstadt and by occupying Stade and Altona. Glückstadt became the Danish staple port for the handling of goods from Iceland and Norway and this proved to be a fatal blow to Hamburg's trade with Iceland. Glückstadt also became a centre of trade with the Guinea coast of Africa. In 1628 the Danes levied high

tolls at Glückstadt on Elbe shipping. In the same year, however, Hamburg secured—by a new charter from the Emperor—fresh privileges on the lower Elbe. Yet in 1633 the Emperor confirmed the right of the Danes to levy tolls at Glückstadt, and in 1643 Hamburg accepted these tolls. Then the fortunes of war changed. The Danes were defeated by the Swedes and the Dutch and in 1645 they gave up the Glückstadt toll and recognized Hamburg's privileges on the Elbe. Hamburg still had the duty of keeping the lower Elbe safe for shipping.

Later in the seventeenth century Denmark again renewed her aggressive policy. A new attempt was made to turn Altona—raised to the status of a city in 1664—into a great rival port on the Elbe. In 1686 the Danes besieged Hamburg, but they were defeated in battle. On this occasion deliverance was due largely to support from a new ally—the Great Elector of Brandenburg. He fully appreciated the economic advantages which his own growing dominions would derive from co-operation with the chief port on the Elbe. Already, by completing the Müllrose C. (known also as the Neuer Graben or Fredrich Wilhelm C.), the Great Elector had enabled inland water-borne traffic from Brandenburg to reach Hamburg. Numerous tolls, however, reduced the advantages which the port gained from the building of this canal. Indeed, the tolls on the whole of the Elbe and Mark Brandenburg system of waterways were, in the seventeenth and eighteenth centuries, a great hindrance to Hamburg's commerce. At that time there were some 48 toll stations on the Elbe between Melnik and Hamburg. Not only was the cost of transport greatly increased by these tolls, but ships and their cargoes were delayed by having to stop so frequently on their journeys. Road tolls were equally burdensome.

After the removal of the danger from Denmark Hamburg was free from the threat of aggression until the rise of Napoleon. But there were serious internal disturbances in the late seventeenth and early eighteenth centuries which came to a head in 1708 and led to the intervention of the Imperial authorities. In 1712 a new constitution was established which lasted until 1859–61. By the Treaty of Gottorp Hamburg's status as a Free City of the Empire was at last fully acknowledged by Denmark. At the same time Hamburg purchased from Denmark territories which enabled her harbours to be expanded and so meet the growing needs of her shipping.

By the end of the seventeenth century Hamburg's citizens owned about 200 merchantmen. On long voyages these ships sailed in

convoys under the protection of armed vessels. Trade extended to virtually all the ports of western Europe. The Greenland voyage was a profitable one for the capture of whales and seals. Goods entering Hamburg in the eighteenth century were, for the most part, not imported on order but were sold by auction on arrival. Industries also made progress in the town. The first German bourse had been founded there as early as 1558—only four years after that of Antwerp—and the city became an important financial centre in northern Europe. The Hamburg *Girobank*, founded in 1619, was soon issuing banco rix dollars and marks banco which became the main currency used by merchants in northern Germany, Scandinavia and the Baltic States. The *Girobank* maintained a sound currency at a time when a great variety of coins—some of doubtful value—were circulating on the Continent. The Hamburg Chamber of Commerce (the *Commerzdeputation*) was founded in 1665. There were over twenty mercantile insurance agents in the port in 1722 and the first mercantile insurance company was established there in 1765. Since the last years of the sixteenth century the town authorities had maintained an efficient post office which enabled merchants to correspond quickly with the main commercial centres of the Continent. By 1695 ten other states had established in Hamburg branch offices of their own postal services. At the same time regular passenger coach services—good by contemporary standards—were operating between Hamburg and large commercial cities such as Leipzig.

Political events favoured the expansion of trade in the eighteenth century. During the Seven Years War, for example, Hamburg merchants were able to extend their trade with Spain, Portugal and the Scandinavian countries. Owing largely to her financial difficulties, Denmark in 1768 sold to Hamburg various territories on the Elbe islands and on the left bank of the river which were useful for future commercial expansion (see p. 70). Then the establishment of an independent United States of America enabled Hamburg ships to trade directly with American ports. Under the former colonial regime such trade had been forbidden by the British Navigation Laws. In 1796 the number of American ships arriving at Hamburg was 239.

The outbreak of the French Revolution and the disorders and wars that followed it were at first of some advantage to Hamburg which gained trade lost by French and (after 1795) by Dutch ports. The British Minister in Hamburg reported that in the years

1795–1807 Hamburg's imports from Great Britain of manufactured articles, colonial produce and East India goods amounted to some £10,000,000 a year—at a time when Great Britain's total exports were valued at about £50,000,000. In the middle of 1803, however—following the renewal of hostilities between England and France after the Peace of Amiens—Napoleon declared the mouth of the Elbe in a state of blockade. Hanover and the Hamburg district of Ritzebüttel (which included the outport of Cuxhaven) were occupied by the French so that they could enforce the blockade. Then towards the end of 1806 General Mortier occupied Hamburg and finally—on 1 January 1811—the Free City was incorporated in the French Empire (Department of Bouch d'Elbe). Altona, however, was not annexed. Napoleon's Continental System barred English goods from the Elbe ports. Hamburg and Altona suffered severely and their overseas commerce was virtually reduced to smuggling, many goods being smuggled by way of Heligoland.

After the collapse of Napoleon's expedition against Moscow a small detachment of Cossacks under Colonel Tettenborn freed Hamburg, but French troops under Marshal Davout seized the adjacent island of Wilhelmsburg and recaptured the port. When relieving allied forces approached the port in December 1813 the French ruthlessly expelled a large number of civilians and most of these refugees perished from hunger and cold. When news came of Napoleon's fall the French troops left Hamburg (30 May 1814). The population of the port had fallen from 132,000 in 1811 to 100,000 in 1814.

After the Napoleonic Wars Hamburg recovered her political independence as a Free City and became a member of the Germanic Confederation (*Bund*). She had to face the task of building a new mercantile marine, of reopening business connexions which had been lost, and of reviving local industries. Difficulties which stood in the way of rapid recovery included the low purchasing power of people in central Europe; the burden of numerous customs duties levied by the various German states; the heavy dues levied on both the lower Elbe (Hanover's Stade tolls) and on the upper Elbe; and the rivalry of other Elbe ports such as Altona (Holstein) and Harburg (Hanover). The Elbe Navigation Act of 1821 facilitated somewhat the shipment of through traffic by the Elbe route. But a quarter of a century later (1847) some of the leading German chambers of commerce complained that the dues on the upper Elbe were twice as high as those on the Rhine and in 1859 the Secretary of the British

Board of Trade condemned the tolls as 'at all times excessive'. The Stade tolls on the lower Elbe were not abolished until 1861. Meanwhile the chaotic state of affairs by which nearly 40 German states each levied customs duties on their frontiers had been greatly improved by the founding of the Zollverein (1834) and its subsequent extension to include virtually all the German states except Austria and the Hansa Towns. But Hamburg viewed with distrust the growing economic power of Prussia in Germany.

Nevertheless, trade had revived in the earlier part of the century and Hamburg had again become the main port by which British manufactured articles (e.g. textiles and metal goods) and colonial goods entered Germany. Moreover, a flourishing new trade had been opened with the South American republics (when they gained their independence from Spain) and also with Brazil. Two disasters had temporarily checked progress in the forties—a great fire in 1842 which destroyed a third of the old inner city, and the Danish blockade of the Elbe during the German-Danish War of 1848–50.

From these disasters the city gradually recovered. Hamburg derived considerable benefit at this time from the improvement of communications in Germany. In 1844 the railway from Berlin reached Hamburg. A few years later (1847) the Köln-Minden railway was extended to Harburg, but the jealousy of Hanover prevented the construction of a continuation of the line across the Elbe to Hamburg. (It was not until 1868–72 that the railway was extended from Harburg to Hamburg.)

In the forties and fifties Hamburg's merchants and shippers were making progress and were laying the foundations of the future greatness of the port. In 1844 Adolph Jacob Hertz of Hamburg sent a ship to Zanzibar and recognized the possibility of trading in cowries, which could be purchased cheaply on the island. These shells found a ready market on the West African coast where they were used as currency. Wm. O'Swald & Co. soon entered this branch of trade and established its first warehouse in Zanzibar in 1849. German trade in East Africa was fostered by the conclusion in 1855 of a commercial agreement between the Hansa Towns and the Sultan of Zanzibar. Meanwhile, in the early fifties Carl Woermann of Hamburg began to trade on the West African coast. Ten years later he had established a virtual monopoly of the commerce between Gabun and the Cameroons. At the same time the Hamburg house of J. C. Godeffroy & Son was gaining control of the copra trade of Samoa in the Pacific.

This commercial expansion in Africa and the Pacific was on traditional lines in the sense that it was carried out by merchant houses which owned or hired the ships that they used for their trading voyages. But a new development was taking place. Shipping firms were being established which simply ran services of passenger and cargo vessels. They were purely shipping concerns and did not engage in any other trade. In 1836 Robert M. Slomann founded the *Segler-Packetfahrt Hamburg-New York* and a few years later (1839–40) he founded the first Hamburg steamship line. In 1847 the *Hamburg-Amerikanische Packetfahrt A.G.* (Hamburg-Amerika Line) was founded. It established a regular passenger service on the North Atlantic route with sailing vessels. In 1856 two steamers (the *Hammonia* and *Borussia*) were added to the fleet of the Hamburg-Amerika Line. Hamburg, however, did not secure any substantial share of the emigrant traffic from its rival Bremen in the middle years of the nineteenth century. In 1840, for example, only 1,407 emigrants left Hamburg for North America in comparison with 12,806 from Bremen. In 1852 the number of emigrants from Hamburg to North America was 22,230 compared with 58,511 from Bremen.

Hamburg's progress was only temporarily checked by the commercial crisis of 1857, but a large loan from the Austrian National Bank permitted a recovery of credit. Financial troubles were followed by a political crisis; after long and heated controversies a new Constitution was adopted (1861).

In the sixties Prussia's wars against Denmark and Austria led to important territorial changes on the Elbe estuary. Since both Schleswig-Holstein and Hanover were annexed by Prussia, that state now ruled all territory on the Elbe below Hamburg (except Ritzebüttel-Cuxhaven). Prussia naturally pressed Hamburg to give up the economic independence that it had so long enjoyed and to join the Zollverein. The city refused, but in 1868 agreed that the Hamburg territories of Fuhlsbüttel, Ohlsdorf, Bergedorf, Ritzebüttel-Cuxhaven and Neuwerk Island should join the Zollverein. A Zollverein customs house and warehouse was established in Hamburg. The Prussian districts of Altona and Wandsbek (which lay so close to Hamburg that it was not practicable to draw a customs frontier between them) were excluded from the Zollverein.

Even after the establishment of a united Reich in 1871 Hamburg (like Bremen) remained outside the German customs system and retained her traditional policy of Free Trade when Germany adopted

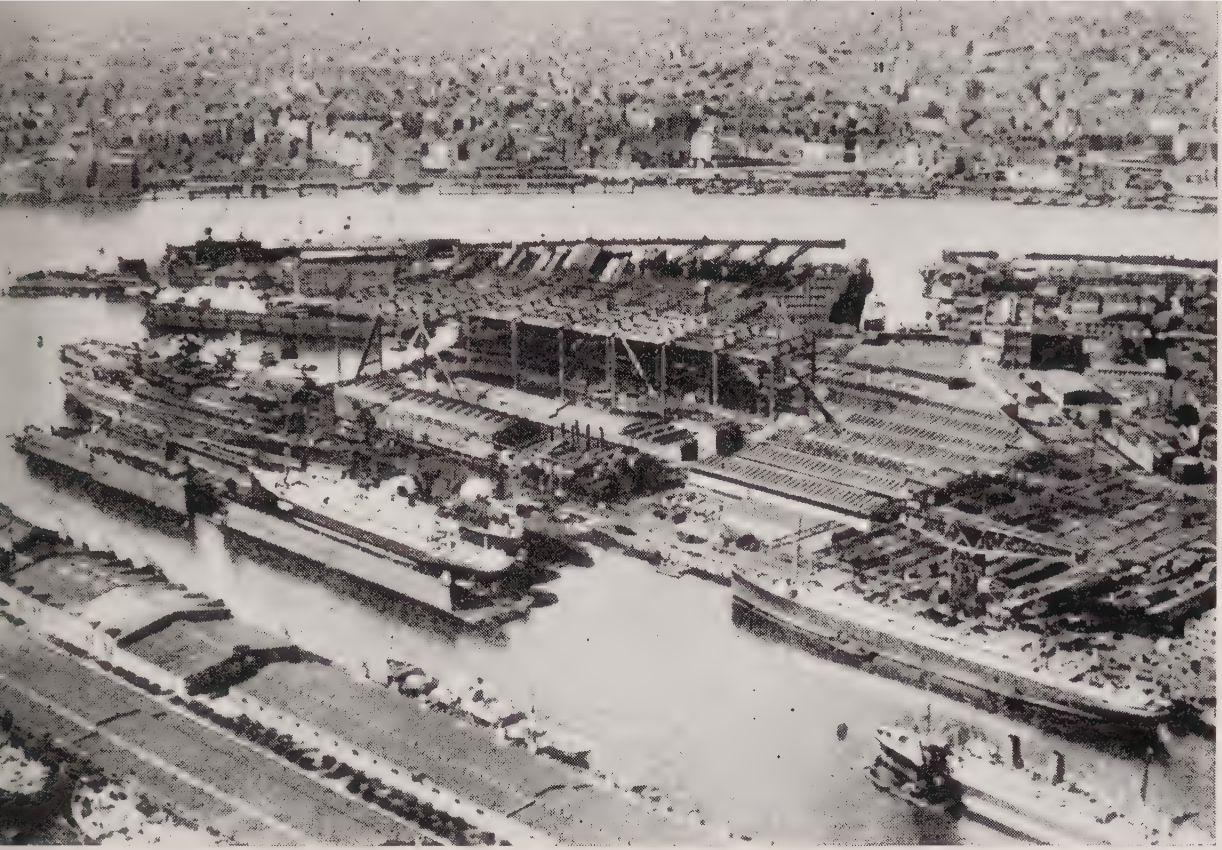

Plate 13. Hamburg: Steinwärder island, looking north

In the foreground several floating docks lie in the Kuhwärder Hafen, and a 250-ton hammerhead can be seen on the Steinwärder Ufer. The *Blohm und Voss* yards occupy most of the part of the island which is visible. Behind lies the Elbe and the city.

Plate 14. Hamburg: Südwesthafen

In the foreground is Hamburg-Süd sorting sidings; behind are modern warehouses on Windhukkai, with the site for Togokai on the right and Kamerun Kai on the left.

Plate 15. Hamburg: Waltershoferhafen, showing dolphin berths

Plate 16. Hamburg: Griesenwärderhafen
Diestelkai is shown under construction.

a policy of Protection in the late seventies. At last, in 1881, Hamburg agreed to enter the German customs system on condition that she secured a large Free Port area (nearly 4 sq. miles). The Imperial Exchequer was to pay half the cost of building the Free Port. The Free Port was constructed for the most part on the south bank of the northern branch of the Elbe and was completed in October 1888. (The Free Port area was enlarged to include the Ross-Neuhoff district in 1908 and part of Waltershof in 1922–3.) The warehousing business of the Free Port was from the first largely in the hands of a single concern—the *Hamburger Freihafen Lagerhaus Gesellschaft* —on whose board sat three representatives of the State of Hamburg. The most important private companies which handled the remainder of the business were Nathan, Philipp & Co, and Eggers, Wright & Co. The continued improvement of Germany's communications—e.g. the opening of the Kiel C. in 1895 and the Elbe-Trave C. in 1900—was also of benefit to the trade of the port.

Traffic of Hamburg Harbour in middle years of the nineteenth century

<table>
<tr><th rowspan="3"></th><th colspan="5">Incoming traffic</th><th colspan="3">Outgoing traffic</th></tr>
<tr><th colspan="2">Seagoing ships arriving</th><th colspan="3">Goods arriving at Hamburg</th><th colspan="3">Goods leaving Hamburg</th></tr>
<tr><th>No.</th><th>Tonnage</th><th>by sea</th><th>by river (in tons)</th><th>by rail</th><th>by sea</th><th>by river (in tons)</th><th>by rail</th></tr>
<tr><td>1826</td><td>2,369</td><td>199,000</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1836</td><td>2,497</td><td>248,000</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1846</td><td>3,779</td><td>419,000</td><td>520,000</td><td colspan="2">407,000</td><td>215,000</td><td colspan="2">375,000</td></tr>
<tr><td>1856</td><td>5,201</td><td>880,000</td><td>1,118,000</td><td>492,000</td><td>158,000</td><td>460,000</td><td>436,000</td><td>173,000</td></tr>
<tr><td>1866</td><td>5,185</td><td>1,328,000</td><td>1,149,000</td><td>485,000</td><td>270,000</td><td colspan="3">No statistics available</td></tr>
</table>

From: L. Wendemuth and W. Böttcher, *The Port of Hamburg*, section VIII, Statistical Data (Hamburg, 1927).

Hamburg's shipping, commerce and industries made rapid headway after 1871. Her ever-growing mercantile marine formed a substantial part of Germany's total merchant shipping (see vol. III of this Handbook, p. 213). In 1860 Hamburg had 483 ships (140,000 tons), of which only 19 were steamers. Twenty years later the steamships alone accounted for 99,000 tons. In 1900 the steamships had increased to 746,000 tons, and in 1912 to 1,400,000 tons. The Hamburg-Amerika Line alone owned 172 steamships of 1,028,762 tons in 1913 and 19 more were in course of construction.

The progress may be seen also by examining the statistics of harbour traffic. In 1876 Hamburg handled 2,178,000 tons of

incoming shipping (2,327,000 tons of cargo). In the same year 929,000 tons of goods arrived by river craft and 864,000 by rail. In 1913 the ships arriving from overseas amounted to 14,185,000 tons and carried cargoes of 16,548,000 tons. In that year 5,382,000 tons of goods came by river and 5,245,000 by rail. Outgoing traffic also increased. In 1876 the cargoes leaving by sea amounted to 726,000 tons and those leaving by river and rail to 393,000 tons and 635,000 tons respectively. In 1913 cargo departures by sea were 8,910,000 tons, by river 7,248,000 tons and by rail 2,615,000 tons.

Traffic in Hamburg Harbour, 1851–1913

Annual average in the years	Number of ships	Tonnage of ships
1851–60	9,301	1,512,354
1861–70	10,177	2,516,455
1871–80	11,015	4,414,014
1881–90	14,036	7,745,695
1891–1900	21,058	13,232,618
1913		28,625,000

From: Werner Sombart, *Der moderne Kapitalismus*. Vol. III, *Das Wirtschaftsleben im Zeitalter des Hochkapitalismus*, Part i, p. 283 (Munich and Leipzig, 1928).

Most of this traffic was carried by passenger and cargo vessels running regular services. To the firms established in the middle years of the century several more were added after 1870. The Hamburg-South America Steamship Company was founded in 1871 and the Kosmos Line in 1872. In the late eighties the German-Australian and the German-Levant lines were established. In 1890 the German East Africa Line was set up with the main object of carrying mails. Meanwhile some of the older firms were greatly expanding their activities. Woermann's services to the west coast of Africa were changed from sail to steam in 1889. The Hamburg-Amerika Line went from strength to strength under Albert Ballin's energetic direction. Direct services were established to South America (1896), East Asia (1898) and—in the early twentieth century—to Arabian, Persian and African ports. The company made substantial profits during the Russo-Japanese war by selling old ships and supplying coal to the Russians. It also secured for Hamburg a greater share than before of the emigrant traffic to America; the emigrants came mainly from Russia and other parts of eastern Europe. By 1913 the Hamburg-Amerika Line had outstripped its rivals and was running ships regularly on between 60 and 70 routes to about 400 ports.

Owing to her many overseas interests it was natural that Hamburg should take a lively interest in the establishment and development of

the (former) German overseas empire. Godeffroy's trade in the South Seas and Woermann's trade on the West African coast laid the foundations of German colonial enterprise in those regions. Adolf Woermann was in close touch with Bismarck in the critical days preceding the founding of the German colonies of the Cameroons and Togoland. After the overseas empire had been established in the eighties of the nineteenth century (see vol. II of this Handbook, pp. 199–201), Hamburg merchants and shippers took an active part in its economic development. The interest of the port in the colonies was shown in various ways. The Hamburg Colonial Institute was founded in 1908 to train colonial officials and prospective settlers. The Institute became a University in 1919. The Hamburg Scientific Foundation (*Hamburgische Wissenschaftliche Stiftung*) sent an important expedition to study the anthropology of the native peoples of some of Germany's colonies in the Pacific. The Hamburg Institute for Tropical Hygiene (*Institut für Schiffs- und Tropenkrankheiten*), founded in 1900, carried out research on tropical diseases and trained doctors for work in the tropics.

Imports consisted of raw materials, manufactured articles, and colonial goods from tropical territories. Exports were partly raw materials, agricultural products and manufactured articles from Germany and other parts of central Europe and partly a variety of goods which were re-exports. There were, of course, changes in the relative importance of various items. Thus imports of coal from Britain sank as improved communications enabled coal from the Ruhr and Upper Silesia to reach new markets in Berlin and central Germany. The increased use of lignite (brown coal) in central Germany also contributed to reduce Hamburg's imports. (But as late as 1906 a fifth of Berlin's coal still came from Britain.) Hamburg's once-flourishing sugar trade with the West Indies gradually collapsed with the rise of German beet-sugar industry. The import of nitrates from Chile (for use as fertilisers) declined in the twentieth century when Germany produced artificial nitrates.

For centuries Hamburg has been an important manufacturing centre as well as a great port. In the middle ages brewing was a principal industry, and in the seventeenth and eighteenth centuries sugar refineries and calico printing flourished, using raw materials from overseas. These industries did not survive the days of Napoleon's Continental System. In the forties of the nineteenth century the milling industry became of importance. Various manufactures connected with shipping developed—the building of

ships, the making of baskets, the baking of ship's bread—but they were long hampered by the privileges of local gilds, and in the middle of the nineteenth century there was some migration of industry to suburbs outside gild control. In the last quarter of the nineteenth century the shipbuilding industry—e.g. Blohm and Voss, the Vulcan yard and the *Deutsche Werft* (on the *Reiherstieg*)—developed rapidly. It was from Hamburg yards that the famous ocean liners *Imperator*, *Vaterland* and *Bismarck*, as well as important units of the German navy, were launched before 1914. After the war of 1914–1918 shipbuilding revived: Blohm and Voss completed the *Europa* (1930), and in 1938 the *Deutsche Werft* launched a greater tonnage of shipping than any other single establishment in the world (see vol. III of this Handbook, p. 304).

The Allied blockade during the war of 1914–1918 had brought Hamburg's vast overseas trade to an end. The export of coal to the Scandinavian states was one of the few trades that could be continued in the war years. Afterwards nearly the whole of the port's mercantile marine was surrendered to the victors. Two years after the armistice Hamburg's quays were still silent and her great warehouses were empty. Political unrest—long before 1914 Hamburg had been a Social Democratic stronghold—added to the city's economic difficulties. But the many natural advantages of the port, coupled with the energy of her shippers and merchants, secured a revival of commerce. At first large bulk cargoes were much less common than before 1914 and their place was taken by small lots of miscellaneous goods. In 1926 the total seaborne traffic (arrivals and departures) actually exceeded that of 1913—31,800 ships of 35,100,000 tons as against 31,700 ships of 28,600,000 tons. A short period of prosperity was followed by the difficult years of the world economic depression. Overseas trade contracted sharply and the Nazi policy of national self-sufficiency did not permit of any substantial revival.

Trade

In 1936, of all shipping entering German ports, 40% was accounted for by Hamburg. This moderate percentage compares with 55–65% for Rotterdam and 80% for Antwerp of all shipping entering Dutch and Belgian ports. Hamburg has a considerable rival in the Weser ports, and a good deal of German overseas traffic moves through Baltic ports. In long-distance traffic, however, the dominance of Hamburg is more pronounced.

While it may be regarded as a great 'world port', Hamburg is inferior to New York, London and Rotterdam. In the period 1934–8 it was also inferior to Antwerp in foreign trade; in both foreign and coastwise trade, over the same period, it kept fairly close to Antwerp (which carries on little coastwise trade), and exceeded it by about one million net tons of shipping in 1938. The average size of ship entering Hamburg is lower than the average for Rotterdam and Antwerp.

Percentage of total traffic of Antwerp, Hamburg and Rotterdam accounted for by each port, 1938

	Percentage of Total	
	Number of ships	Net tonnage
Antwerp	24·7	28·92
Hamburg	39·04	30·44
Rotterdam	32·26	36·16
New Waterway	36·26	40·64

From: *Rotterdam: Statistiek, etc., 1938*, p. 17 (Rotterdam, n.d.).

As in most big commercial ports of Europe, the great majority of ships entering are of moderate size.

By flag, just over half of the shipping using the port in 1938 was German, more than three times the amount under the British flag, which was next in importance. Only the Dutch, Norwegian and United States flags contributed any further significant share.

Shipping entering Hamburg, 1938, *by flag* (*in thousands of registered tons*)

German	10,474
British	3,059
Dutch	1,841
Norwegian	1,378
North American	1,203
Danish	520
Swedish	373
French	300
Panamanian	289
Japanese	210
Greek	178
Italian	168
Total all flags	20,567

From: *Handel und Schiffahrt des Hafens Hamburg im Jahre 1938*, p. 6 (Hamburg, 1939).

British vessels include both tramps and short-sea traders, as well as a certain number of deep-sea liners.

Liner Sailings. A considerable number of regular sailings are made to neighbouring countries, although the ships engaged are mostly small. All lines in the German coastwise traffic are German. A prominent feature of the liner traffic is the great number of

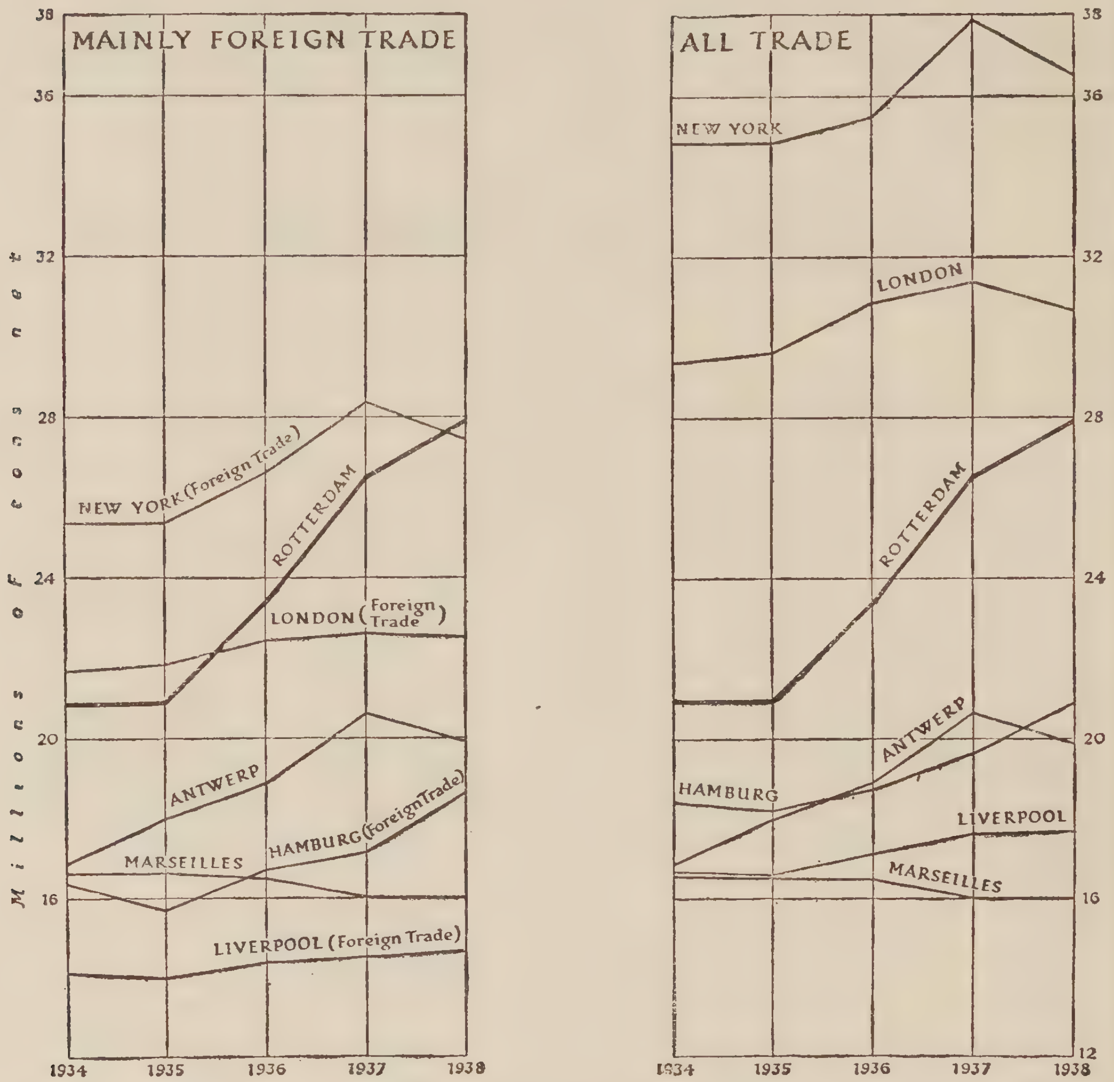

Fig. 24. Tonnage of shipping entering Hamburg and certain other ports, 1934–8

Based on data from *Rotterdam: Statistiek van Handel, Nijverheid en Verkeer, 1938, I–IV*, pp. 18–19 (Kammer van Koophandel en Fabrieken, Rotterdam, n.d.).

Of all shipping entering the ports shown, coastwise traffic accounts for a very small proportion at Antwerp and Rotterdam, for a considerable proportion at Hamburg and for a large proportion at Liverpool, London and New York. For Marseilles figures are not separately given.

services to distant countries. More regular voyages were made in 1938 to ports in the Americas than to all German and European ports, while regular voyages to ports in Asia, Africa and Australia also exceeded the number of voyages to all German and European ports.

Liner services, 1934–8, showing number of lines and voyages, and net tonnage (tonnage in thousands)

		Total			German lines		
		Lines	Voyages	Tonnage	Lines	Voyages	Tonnage
Germany	1938	25	2,338	794	25	2,338	794
	1934	21	2,058	680	21	2,058	680
Rest of Europe	1938	77	4,596	2,600	28	1,640	899
	1934	81	4,433	2,626	29	1,920	918
America	1938	34	868	4,403	17	510	2,441
	1934	42	792	3,889	20	382	1,891
Africa	1938	24	449	1,298	13	288	727
	1934	21	344	863	11	215	449
Asia	1938	20	397	1,724	6	171	696
	1934	24	439	1,766	7	159	571
Australia	1938	4	87	396	—	—	—
	1934	4	76	332	—	—	—

From: *Handel und Schiffahrt, etc.*, p. 37.

Origin of shipping entering and leaving Hamburg, 1938 (*in thousands of registered tons*)

Ports	Inwards		Outwards	
German	2,114		2,621	
Bremen		894		1,118
Other European	6,310		7,686	
Finnish		199		233
Swedish		352		473
Norwegian		570		644
Danish		493		619
British		2,130		2,810
Netherlands		650		1,458
Belgian		546		459
Italian		230		202
Roumanian		217		131
French		107		276
American	6,492		5,565	
N. American Atlantic		2,882		2,511
C. American, W. Indian, Colombian (Atlantic) and Venezuelan		1,446		1,047
Brazilian, Argentinian and Uruguayan		1,472		1,432
Chilean		418		349
African	1,654		1,398	
West coast		913		656
East coast		528		517
Asiatic	3,304		1,923	
British possessions		814		449
N.E.I.		588		195
Chinese		155		42
Japanese		1,180		831
Australian, etc.	186		405	
From no port, e.g. 'Kraft durch freude' cruises	507		507	
Total	20,567		20,547	

From: *Handel und Schiffahrt, etc.*, pp. 2–5.

Origin of shipping. With all shipping using the port, however, traffic from European ports appears heavier, for there is a good deal of tramp shipping with such cargoes as timber from the Baltic and grain from the Black Sea. One-third of all shipping from non-German ports in Europe originated from British ports in 1938; in outward sailings the proportion destined for British ports was even greater.

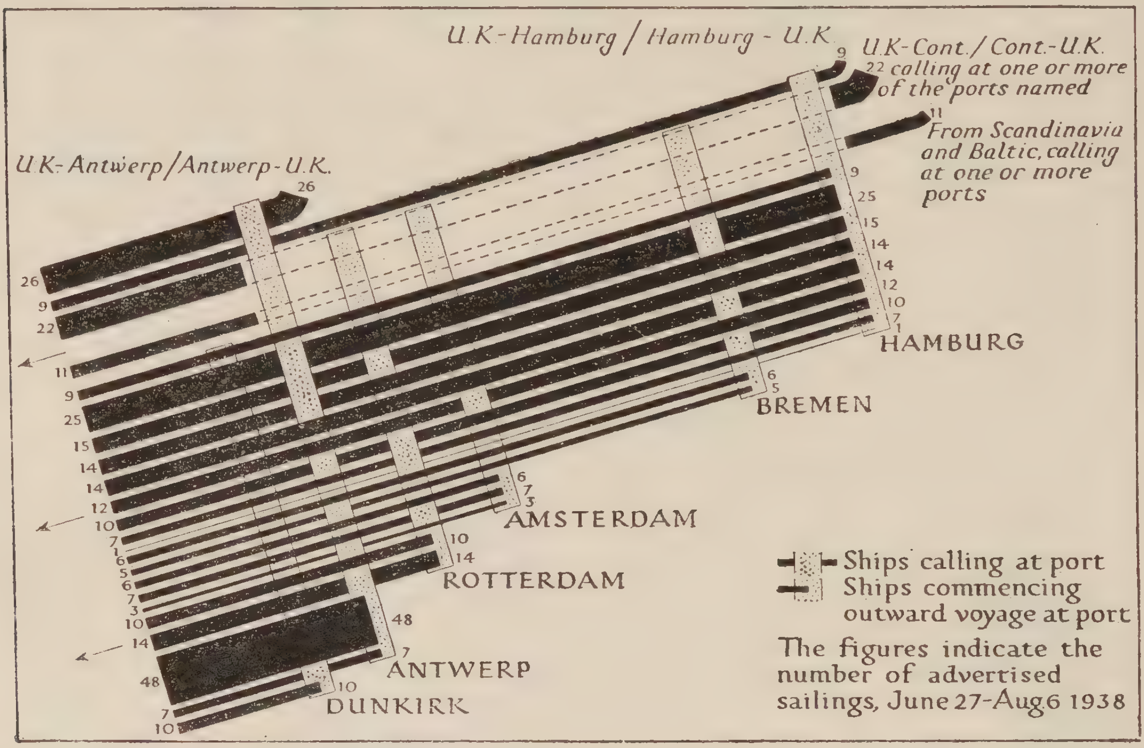

Fig. 25. Advertised liner sailings from continental North Sea ports, 27 June–6 August 1938

Based on data from *Lloyd's Loading Lists*, June, July, 1938 (London, 1938).

The figures and lines indicate the number of advertised sailings to all destinations west of Dunkirk, excluding the British Isles, according to the various ports from which they were to begin or at which they were to call. There were 33 sailings involving U.K. ports and 11 involving Scandinavian ports. Of the sailings which concerned continental North Sea ports only, 107 commenced at Hamburg, 55 at Antwerp, 24 at Rotterdam, 16 at Amsterdam, and 11 at Bremen; in addition, however, 76 called at Antwerp, 29 at Rotterdam, 50 at Bremen and 12 at Amsterdam. There were available, for shipment from north-west continental Europe, 131 sailings from Antwerp, 107 from Hamburg, 63 from Rotterdam, 61 from Bremen and 28 from Amsterdam. A discussion of liner traffic will be found in Appendix IV.

The liner traffic is extremely well organized, and lines connect the port with all parts of the world. In the period 27 June—6 August 1938, for example, 107 vessels were advertised as commencing their voyage at Hamburg, while 24 called after leaving Scandinavian and Baltic ports, and after or before leaving British ports. Antwerp,

however, in the same period, had a greater number of liner sailings: while only 55 vessels were advertised to begin their voyages at that port, 132 sailings from German, Dutch and British ports made calls there (see Fig. 25 and Appendix IV).

Connexions with certain ports show the effect of vessels calling at a number of ports, and are inflated by the counting of some vessels more than once. These statistics show the importance of passenger and cargo liner services, many of which make a great number of calls.

Shipping Traffic with certain ports 1938 (*in thousands of net tons of shipping*)

Port	Incoming	Outgoing
Bremen and Bremerhaven	2,324	4,177
London	1,880	836
Hull, Goole, Immingham	496	576
Newcastle-upon-Tyne	503	481
Plymouth	787	787
Southampton	987	987
Cobh	697	697
Amsterdam	1,007	968
Rotterdam	3,630	3,510
Antwerp	3,007	4,457
Cherbourg	602	644
Le Havre	1,581	1,102
Marseilles	652	296
Lisbon	911	1,253
Genoa	617	777
New York	1,474	1,454
Santos	1,006	982
Port Said	1,965	1,547
Suez	1,120	798
Colombo	1,455	676
Singapore	1,449	873

From: *Handel und Schiffahrt, etc.*, pp. 8–25.

Sea-borne cargo, 1938 (*in thousands of tons*)

	Imports	Exports	Total
Rotterdam	27,504	19,261	46,765
London	34,538	7,540	42,078
Hamburg	18,047	7,238	25,285
Antwerp	11,873	11,706	23,579
Newcastle	2,224	13,069	15,293
Liverpool †	8,821	2,765	11,586
Marseilles	6,712	3,243	9,955
New York coastwise	33,821*	8,354*	42,175
foreign	12,835*	10,413*	23,248
total (1940)	46,656*	18,767*	65,423*

From: *Rotterdam: Statistiek, etc.*, pp. 56–7; *Handel und Schiffahrt, etc.*, 1938, pp. 40, 94, and other sources.

* Short tons (2,000 lbs.).

† Excluding coastwise traffic. The figures for the European ports, except Liverpool, include coastwise traffic.

Cargo. In the volume of sea-borne freight handled Hamburg was, in 1938, the third largest port in Europe; the cargo handled slightly exceeded that passing through Antwerp, but was far behind the weight handled at London and Rotterdam.

Hamburg is similar to London in having a pronounced inward excess of cargo. Its imports comprise mainly foodstuffs and raw materials, while its exports are largely the products of industry in central Germany and other parts of central Europe. It is too far away from the Ruhr to share with Rotterdam, to any great extent, the export of Westphalian coal and steel, and it does not enjoy the

Fig. 26. Cargo trade of Rotterdam, London, Hamburg, Antwerp, 1935–8

Based on data from *Rotterdam: Statistiek, etc., 1938*, pp. 56–7 (Rotterdam, n.d.). The graphs show that, of the four largest ports in Europe, Hamburg resembles London and differs from Rotterdam and Antwerp, in having a pronounced excess of inward over outward cargoes.

advantageous position of Antwerp in being able to draw upon the steel producers of Lorraine, Belgium, Luxembourg and Westphalia for heavy exports. While the weight of exports amounted to less than half of the weight of imports, the value of exports in 1938 (2,861 thousand million R.M.) was two-thirds of the value of imports (3,294 thousand million R.M.).

Coastwise Trade. The coastwise trade is considerable (see facing page).

Two principal items in the coastwise trade are an inward movement of about 50,000 tons of coal from Emden and an outward movement of about 350,000 of liquid fuels to most German ports. The remainder of the traffic is made up of a great variety of commodities.

Coastwise Trade, 1938 (*thousands of tons*)

	Outwards	Inwards
East Prussia	323	125
Pomerania	329	110
Weser, Jade and Ems ports excluding Bremen and Oldenburg	154	555
Bremen	409	145
Rhine region	1,022	564
Total, incl. other ports	2,501	1,585

From: *Handel und Schiffahrt, etc.*, pp. 39, 93.

Foreign Trade. Although European countries contribute very largely to the import trade of Hamburg, over one-half of the total is derived from the Americas and Asia.

Principal suppliers of imports, 1938 (*in thousands of tons*)

Europe (excluding German ports)	6,020	
Great Britain and N. Ireland		2,931
Roumania		326
Norway		314
Africa	1,175	
Asia	2,420	
British India		637
Manchukuo		514
America	6,660	
U.S.A.		2,249
N.W.I.		1,365
Argentina		660
Brazil		566

From: *Handel und Schiffahrt, etc.*, pp. 39–40.

Exports, on the other hand, show a different trend: coastwise trade to German ports and the group of European importing countries each take more than one-third, leaving less than one-third to Asia, Africa and the Americas. Heavy exports tend to move chiefly to nearby destinations.

Principal receivers of exports, 1938 (*in thousands of tons*)

Europe	2,814	
Denmark		537
Great Britain and N. Ireland		500
Norway and Sweden		607
Africa	333	
Asia	558	
America	979	
U.S.A.		341

From: *Handel und Schiffahrt, etc.*, pp. 93–4.

One-half of the imports of Hamburg in 1938 by weight were accounted for by minerals and metals, and one-quarter by agricultural

Imports, 1938 (*in thousands of tons*)

Agricultural products	4,640	
Wheat		422
Maize		841
Rice		270
Oilseeds		1,115
Raw cotton		152
Jute		108
Fruit		438
Coffee		199
Cacao beans		140
Forest products, mainly timber	803	
Animal products	951	
Beef		45
Herring		110
Fish oil		176
Wool		99
Hides and skins		161
Partly worked materials	906	
Vegetable oils		127
Bran		142
Oilcake		500
Minerals	8,373	
Phosphate of lime		481
Copper ore		251
Pyrites		245
Other ores		200
Coal		3,008
Coke		127
Lubricating oil		329
Petroleum		628
Petroleum products		2,658
Chemical materials	528	
Sulphur		79
Chilean nitrates		204
Textile materials, etc.	75	
Paper, pulp, etc.	355	
Metals	1,022	
Iron and steel		198
Iron and steel scrap		242
Copper		385
Other non-ferrous metals		162
Machinery, etc.	83	
Ships		30
All imports	18,047	

From: *Handel und Schiffahrt, etc.*, pp. 39–92.

products, which, however, were more than one-third of all imports by value. A characteristic of many of the imports of Hamburg is that they are drawn from a great variety of sources. Wheat, for example, was supplied by India (30%), North America (30%), Argentina, Roumania and Australia. More than half of the maize import was supplied by U.S.A., with large quantities coming from Argentina and Canada. Nearly half of the rice came from Burma, and most of the rest from other parts of south-eastern Asia, but

34,000 tons were supplied by Italy. Oilseeds were imported from all the leading suppliers, with India outstanding for ground nuts, Argentina for linseed, Manchukuo for soya-beans, Nigeria for palm kernels, and N.E.I. for copra.

Of the cotton import, Brazil was the chief source, followed by India, Egypt, Argentina, Peru, and U.S.A.; jute was supplied almost solely by India. Two-thirds of the tobacco imported came from Greece, Turkey and Bulgaria, and most of the rest from Brazil, Colombia and Cuba. Of the large import of fruit, the Cameroons provided more than half of the bananas, and Brazil was the leading supplier of sweet oranges. Brazil and other South and Central American countries provided most of the coffee, and contributed nearly half of the cacao, for which Nigeria and the Gold Coast were the leading suppliers. The timber imported into Hamburg came mainly from tropical countries, especially French and Spanish possessions in Africa.

The import of beef was supplied almost entirely by Argentina and Uruguay. Great Britain supplied more than one-third of the salted herring and three-eighths of the fresh herring, five-eighths coming from Norway. Most of the other fresh fish imports were Norwegian. Nearly half of the fish oil imported was from the Antarctic, Norway and Japan being the leading foreign suppliers. Wool was supplied mainly by Argentina, Uruguay and South Africa, with Great Britain providing 5,600 tons; hides and skins came from a wide variety of sources including European countries, but Argentina, Brazil and Uruguay were outstanding. Half of the oil-cake imported came from India and Brazil.

Among minerals fuels were outstanding. Of the 3,000,000 tons of coal entering the port, 2,486,000 tons were supplied by Great Britain, 498,000 by the Weser and Ems ports, and 13,000 tons by Poland. Great Britain and the Netherlands accounted for practically all the 127,000 tons of coke. Imports of petroleum and petroleum products came from a variety of sources. (See table on next page: quantities in thousands of tons.)

Raw materials for chemical industries came partly from the Rhineland and partly from the native sources—sulphur from Italy and U.S.A., nitrates from Chile. Paper and paper pulp came principally from the Baltic producing countries, but also in considerable quantities from Pomerania, East Prussia and the Rhineland.

Raw and semi-manufactured iron and steel came from a great variety of sources, although the total import was not large (198,000

	Lubricating oil	Petroleum	Petrol	Gas oil	Fuel oil	Others
Rhineland	72	—	1	1	—	—
Great Britain	4	—	8	—	—	—
Netherlands	1	—	42	—	—	—
Roumania	8	22	158	32	1	—
U.S.S.R.	28	—	—	18	—	—
U.S.A.	184	136	224	420	—	—
N.W.I.	28	93	210	410	425	183
N.E.I.	—	—	115	—	—	—
Iran	—	—	35	—	12	—
Mexico	—	162	43	106	28	3
Peru	—	—	29	18	—	—
Venezuela	—	202	—	—	—	—

From: *Handel und Schiffahrt, etc.*, p. 74.

tons)—e.g. pig-iron from Great Britain, Spain and India, but the chief supplier was the Rhineland. Of an import of 242,000 tons of scrap, the U.S.A. supplied 186,000 tons and Great Britain 36,000 tons. The import of non-ferrous metals reflects the variety of German metallurgical industries. Copper was drawn from all the principal producers abroad, lead chiefly from Mexico, U.S.A. and Australia, zinc from Belgium and Norway, tin from the Netherlands, N.E.I. and Malaya, aluminium from Norway and Canada, and nickel from Great Britain.

The destinations of the exports were extremely varied, but certain important movements stand out. The export of agricultural products was mainly coastwise to other German ports, especially the Rhineland and Bremen, although there was some re-export of cereals and maize to foreign countries, especially in the Baltic. Some of the oilseeds were re-exported to the Netherlands; small quantities of raw cotton were re-exported to many European countries, but 25,000 tons of the total of 41,000 tons went to Bremen, which also took large quantities of jute, tobacco and coffee. Cacao was destined mainly for the Rhineland and the Netherlands. Timber and sugar were re-exported to many countries, although the bulk of the sugar went to European countries and other German ports. Of the export of oilcake, 212,000 tons (about half) went to Denmark, nearly 100,000 tons to Norway and Sweden, and most of the rest to German ports.

Among mineral products, cement had a world-wide export. Mineral oils, gasoil, etc., went mainly to German ports and neighbouring countries. The Baltic countries and Norway took most of the export of salt, and a great part of the potash, for which other important recipients were Great Britain, U.S.A. and New Zealand.

Exports, 1938 (*in thousands of tons*)

Agricultural products	1,565	
Wheat		413
Maize		336
Coffee		62
Cacao beans		46
Barley		65
Malt		60
Rice		57
Oilseeds, etc.		87
Cotton		41
Forest products	240	
Timber		165
Animal products	251	
Partly worked materials	1,044	
Refined sugar		117
Oilcake		443
Minerals	1,135	
Cement		132
Oils, petroleum products, etc.		515
Chemicals, including certain oils	1,056	
Salt		145
Potash (Kalisalze)		126
Chilesaltpetre		119
Sulphate of ammonia		105
Sulphate of potash, etc.		137
Textile raw materials and products	74	
Leather and leather goods, rubber, wooden goods	88	
Paper, etc.	525	
Glass and glassware	106	
Metals and products thereof	607	
Machinery, electro-technical goods, locomotives and vehicles	381	
All exports	7,238	

From: *Handel und Schiffahrt, etc.*, pp. 93–180.

Denmark and Sweden took the bulk of the Chilesalpetre; Japan, China and Denmark the bulk of the sulphate of ammonia; and U.S.A., Great Britain and Japan the bulk of the sulphate of potash. Chemical products as a whole were exported to many countries throughout the world.

Textiles went to almost every foreign country, especially the more distant ones. The U.S.A., Great Britain and Italy were the chief recipients of crude paper and pulp. Manufactured paper had a very wide range of destinations, outstanding among which were Great Britain and the U.S.A. Glass and glassware were exported to most countries in the world, with Great Britain as a leading recipient.

The wide range of German exports appeared most clearly in the categories of metals, metal goods and machinery. Important recipients were Great Britain (machine tools, miscellaneous machinery,

metal goods, and cables), South Africa (locomotives, rolling stock and farm machinery), U.S.S.R. and Japan (machine tools), Greece, India, Argentina, Brazil, U.S.A. (textile machinery), Finland and Turkey (paper-making machinery), India (food-processing machinery and heavy and general electrical equipment), U.S.S.R. (cables), Irish Free State, Netherlands, Norway, Spain, Hong Kong and Manchukuo (ships). The South American countries, especially Brazil and Argentina, were well represented in nearly all categories of metal goods and machinery.

Waterway Traffic. In 1938, 9,861,000 tons of cargo arrived at and were dispatched from Hamburg, making it one of the greatest waterway ports in Europe and the third largest in Germany after Duisburg and Berlin.

Goods entering and leaving Hamburg by waterway, 1938, *in thousands of tons, gross*

	Incoming	Outgoing
	Upstream	Downstream
From Lower Elbe	283	589
	Downstream	Upstream
Elbe from Saxony to Magdeburg	680	1,047
Magdeburg	295	968
Elbe in Saxony	431	622
Elbe in Sudetengau	21	42
Czechoslovakia	485	372
Saale	311	220
Mittelland C.	1	2
Elbe-Lübeck-C.	581	68
other Elbe tributaries	50	48
Oder in Pomerania	6	1
Breslau	46	150
Remaining part of Oder	362	102
Warthe in Germany	10	21
Berlin	119	1,421
Havel and other Mark waterways	136	367
Total downstream and total upstream	3,535	5,453
Totals, incoming and outgoing	3,818	6,043

From: *Handel und Schiffahrt, etc.*, p. 181–9.

There is thus a pronounced excess movement upstream or inland, arising from the function of Hamburg as an importer of bulky foods and raw materials for central Germany. Below Hamburg, i.e. in the estuary, the chief cargoes are cement moving upstream and coal and liquid fuels moving downstream. Cargoes from the Elbe between Saxony and Magdeburg are very mixed, but outstanding items are potash fertilizer downstream (147,000 tons) and mineral

Plate 17. Hamburg: Neuer Petroleum Hafen (1932), looking north-east

Plate 18. Hamburg: Tiefstack power station and gasholder, looking north
The barges are lying in Holzhafen.

Plate 19. Hamburg: Elbe bridges, looking north

The railway bridge, to the left, is the most important rail crossing of the Norder Elbe. In the left background is the Baakenhafen, in the right background the Oberhafen barge canal.

Plate 20. Brunsbüttelkoog: western entrance to Kiel Canal, looking west

raw materials (500,000 tons), maize and petroleum products upstream. Magdeburg sent 58,000 tons of sugar downstream; the heavy upstream traffic included 390,000 tons of coal. Downstream from Saxony the chief items were lignite (104,000 tons), stone (113,000 tons) and paper (84,000 tons); upstream the largest cargoes were maize and iron and steel scrap (each 53,000 tons). From Czechoslovakia the chief cargo downstream was sugar (105,000 tons), and upstream, oilseeds (100,000 tons). Traffic along the Elbe-Lübeck (Trave) C. was almost entirely downstream: the chief item was earth and sand—529,000 tons. Berlin sent little cargo downstream, for it is a consumer of bulky foodstuffs and raw materials and an exporter of highly fabricated articles, which usually go by rail; the chief upstream cargoes to Berlin were coal (278,000 tons), coke (176,000 tons), petroleum products (359,000 tons), and cereals. The upper and middle Oder (excluding Breslau) sent to Hamburg three and a half times as much cargo as it received—the outstanding item downstream was coal and coke (315,000 tons).

It should be remembered that a considerable quantity of the waterway traffic of Hamburg is coastwise in origin, comprising Ruhr coal which reached Berlin by way of the Dortmund-Ems C., Emden, Hamburg and the Elbe. With the opening of the Mittelland C. this traffic has declined to some extent, for traffic between the Ruhr and Berlin can now move all the way in the same barge.

Rail Traffic. More than half of the movement of goods into and out of Hamburg is carried by rail, important as its waterway connexions are. It profits from its comparative proximity to Berlin and Saxony, and draws a considerable traffic from Silesia, as well as Austria and Czechoslovakia, while smaller quantities of merchandise pass between the port and Switzerland and the Balkan countries. In Germany itself the distribution of traffic among the principal districts dealing with the port in 1937 is shown in the table on the next page.

The table shows that for all goods conveyed by rail, the advantage of Hamburg over Bremen is clear enough for all regions to the east and south-east. The figures for Berlin and Brandenburg are low, for much of the traffic is in bulk goods carried by waterway. The traffic of central Germany is dominated by Hamburg, while the traffic with Hanover and Oldenburg, an area which is near both of the ports, is shared fairly equally. Traffic with the Ruhr is much greater with Bremen than with Hamburg, mainly owing to the heavy movement of coal to the Weser, for, of the outward traffic

Rail movement, to and from Elbe and Weser ports by principal districts, 1937 (*in thousands of tons*)

Traffic District Nos.*	Area	From Elbehäfen	To Elbehäfen	From Weserhäfen	To Weserhäfen
8	Elbehäfen	593	593	93	83
9	Weserhäfen	83	83	262	262
5	Pomerania	124	96	11	6
6	W. Baltic ports	187	157	25	12
7	Schleswig-Holstein	390	339	12	16
11a	Oldenburg	436	507	454	478
11b	Hanover	282	306	189	405
16	Berlin	149	100	52	25
17	Brandenburg	181	149	25	13
18	Magdeburg and Anhalt	129	201	36	102
19a, 19b	Merseburg, Erfurt, Thuringia	208	455	45	219
20, 20a	Saxony, Leipzig	240	236	113	65
2	Hessen-Nassau	63	241	8	144
22–26a, 28	Ruhr and Lower Rhine	601	4,195	421	5,874
27	Saar	17	22	123	32
33, 35	Baden, Württemberg	147	114	53	31
36, 36a	S. Bavaria, Munich	316	121	48	32
37	Bavaria	128	89	42	35
	Total all districts	3,988	7,718	1,844	7,644

From: *Güterbewegung, etc.*, Heft I, pp. 24–35; Heft II, pp. 26–37.

* See p. 280.

to the Ruhr, that of Hamburg is 50% greater. The greater part of the rail traffic with the Saar passes to Bremen, but for the traffic of south Germany Hamburg is dominant, although it has no big advantage in distance.

An appreciable proportion of the rail traffic of Hamburg is conducted with neighbouring foreign countries—8–10%; of this about half is on Czechoslovakian account. Exchanges for foreign countries are all bound up with the question of competition between the port and Rotterdam, Antwerp, Marseilles, Genoa, Trieste and Gdynia (see p. 293).

Further discussion of the rail traffic of Hamburg will be found on p. 50–3.

Industries

After Berlin, Hamburg is the largest single centre of industry in Germany. Manufacturing industries have developed to a much

greater extent than in the great rival ports of Rotterdam and Antwerp, mainly owing to the much greater size of the home consuming market. The industries of Hamburg appear at first to be extraordinary varied, but they may be grouped conveniently enough under two principal headings: (i) all kinds of refining industries, (ii) shipbuilding, engineering and metal industries.

Refining Industries. A large port is frequently the centre of industries which consist primarily of the treatment of crude or semi-crude raw materials, which are easily imported in bulk by sea, but which are often more economically distributed within the consuming area in a refined or semi-refined form. Oil refining, soap manufacture, and chemicals are examples of such industries, and are represented at most large ports.

Hamburg is the chief centre of petroleum refining in Germany (as distinct from the production of synthetic liquid fuels, an industry which is most economically carried on near the coal and lignite beds which provide the basic material). The refineries of the Hamburg district were the following:

Location	Estimated annual capacity, thousand tons
Harburg	550
Petroleum-hafen	400
Harburg	400*
Ostermoor**	150*
Heide Hemmingstedt**	150
Grasbrook	130
Wilhelmsburg	70
Grasbrook	65†
Wilhelmsburg	40†
Grasbrook	36†
Schulau (near Wedel)	35
Schulau	10

From official sources.

* Mainly asphalt production. † Lubricating oil plant. **Neor Kiel Canal.

The largest refinery outside Hamburg, a dual plant at Misburg near Hanover, had a capacity of 300,000 tons.

The facilities for oil storage are considerable, though in this respect Hamburg is not so pre-eminent as in refinery capacity. While much greater than the total capacity of the chief inland storage centres, storage only slightly exceeds the capacity at the Weser ports.

The refining of metals, based largely upon imported ores and concentrates, was carried on principally by the *Norddeutsche Affinerie*, the most important copper smelting and refining plant in Germany, with a refinery capacity of 120,000 tons per annum. Situated on

Estimated oil storage capacity (thousand tons)

Hamburg	1,361	Hanover	287
Bremen	749	Frankfurt-am-Main	141
Bremerhaven	460	Munich	69
Kiel	1,208	Berlin	69
Wilhelmshaven	221	Duisburg	66
Stettin	187	Düsseldorf	32
Emden	43	Stuttgart	17
Rostock	11	Köln	14

From official sources.

both sides of the Muggenburg C., this plant also produced lead (14,000 tons annually in the years preceding 1939), electrolytic tin, and cobalt, as well as considerable quantities of sulphuric acid. A second plant produced sulphuric acid and others dealt with copper scrap and copper sulphate, zinc white, zinc oxide, and mixed tin. There were also six factories which fabricated lead in various forms.

A related group of chemical industries included a large superphosphate works, an 80-oven coke-oven plant, and the production of potassium nitrate. Other industries included the production of pharmaceutical products, leather manufacture, three important paint and varnish factories, and the manufacture of casein resins.

The vegetable oil industry was considerable. Six mills accounted for a total capacity in oilseeds crushed or extracted of about 700,000 tons annually, or nearly half of the entire capacity in Germany. There were two plants engaged in the hydrogenation of marine and vegetable oils, and four important soap factories.

The distant and far-ranging connexions of the port appear in two further considerable industries based upon the processing of imported raw materials—tobacco and rubber. Several tobacco factories at Hamburg account for 20% of the German output of cigarettes. Rubber factories include the *Phoenix* works at Harburg, which had in 1939 an estimated monthly output of 50,000 tyres, and twenty-one others engaged in related operations—reclamation, chemical supplies for the rubber industry, re-treading, roofing, etc. Nine companies engaged in the distribution of raw rubber supplies for which Hamburg was the most important centre in Germany.

The port was a leading centre of milling. Three flour mills had a combined output of 650 tons per day, and other mills handled corn, oats and rice. There was also a considerable industry of distilling, carried on by five important distilleries of potable alcohol.

Other miscellaneous industries included the manufacture of sanitary ware, three galvanizing plants, and jute mills.

Shipbuilding, Engineering and Metal Industries. The largest single industry of Hamburg is shipbuilding, carried out in five large yards and many smaller ones (see p. 65). The largest of these, *Blohm und Voss*, together with the *Howaldtswerke*, has extensive machine shops, foundries, etc. Although some engines are supplied by the works of Berlin, Augsburg, etc., the complementary industry of marine engineering is considerable, and the M.A.N. diesel-engine plant attached to the *Howaldtswerke* is one of the largest in Germany, while M.A.N. diesels are also constructed by *Blohm und Voss*, and other diesels by the *Hanseatische Motoren Ges. Howaldtswerke*, as well as *Blohm und Voss*, also produce reciprocating engines. A third producer of reciprocating engines is the *Ottensenser Eisenwerke. Blohm und Voss* construct boilers. Other engine constructors include a producer of motors and generators of moderate size, which is a leading producer in Germany after *Siemens*, *A.E.G.*, and *Brown Boveri*, and a constructor of self-contained diesel sets. Industries ancillary to shipbuilding include the manufacture of electrical equipment for marine use, davits (of which *Ottensenser Eisenwerke* is a well-known maker), propellers (*Zeise*), 'Simplex' rudders (*Deutsche Werft*), anchors and chains, sea-water distillation plants, signalling gear, navigation lights, pressure-tube and echo-sounding devices, marine logs, tank gauges, ships' compasses, and navigating instruments such as sextants and bubble octants. Several firms produce oxygen sets, welding equipment and oxygen.

General engineering activities are largely related to the manufacturing and processing industries of the port, as well as the equipment of the port itself. The *Kampnagel Eisenwerk A.G.* specializes in cranes, from hammerheads downwards, and has supplied 700 cranes to the port authorities; the company also constructs refrigerating plants, corn mills and rice-processing machinery. *Arnemann* produces elevators and coaling plants; the *Harburger Eisen- und Bronzewerk A.G.* constructs machinery for oilseed crushing, etc., for margarine manufacture and for mixing rubber. Other manufacturers produce machinery for the chemical, dye and chocolate industries, washing machines and centrifuges, brewery and distillery plant and refrigerating machinery. (In 1939 Hamburg was the site of one-third of all cold-storage plants in Germany.) Miscellaneous engineering activities include the manufacture of agricultural machinery, agricultural tractors, and small vans and lorries. The aircraft industry was represented by coastal aircraft (*Blohm und Voss*), aircraft components, and aero-engines (*Klockner-Humboldt-Deutz*.)

Communications

Rail. The quays and basins are well served by many rail tracks, which converge towards easterly points to connect with the main north-south crossing of the two branches of the Elbe. Apart from various sidings, three of the marshalling yards (Eidelstedt, Rothenburgsort, and Wilhelmsburg) have daily capacities of 4,000, 3,300 and 4,800 wagons, respectively. The total of traffic by rail in 1938 was greater than the total for the waterways (see below); 7,178,000 tons (gross) were brought into the port and city by rail, and 5,206,000 tons dispatched. The figures for 1937, which are analysed on pp. 97–8, were 7,718,000 tons inward and 3,988,000 tons outward.

The importance of the various goods stations is shown in the following table:

Distribution of railway goods traffic by station, 1938, *in thousands of tons gross* (*brutto*)

Goods station	Inwards			Outwards		
	Wagon-loads	Packed goods	Total	Wagon-loads	Packed goods	Total
H. Hgbf. Berlin	2,348	272	2,620	—	—	—
H. Hgbf. Hannover	—	—	—	750	152	902
H. Hgbf. Kai, rechts	188	—	188	213	3	216
H. Hgbf. Eilgut	37	19	56	36	23	59
H. Hgbf. Süd	1,302	9	1,311	1,725	16	1,741
H. Sternschanze	170	2	172	38	1	39
H. Barmbeck	305	8	313	24	16	40
H. Ohlsdorf	38	1	39	3	1	4
H. Bergedorf	266	8	274	114	11	125
H. Altona	419	25	444	159	46	205
H. Altona Eilgut	14	13	27	71	81	152
H. Harburg	163	17	180	167	15	182
H.U.E.	240	26	266	828	6	834
H. Wilhelmsburg	706	13	719	509	24	533
Other stations	431	20	451	115	29	144
Total	6,739	439	7,178	4,777	429	5,206
Private railways:						
H. Altona	3	—	3	—	—	1
H. Stellingen	92	1	93	18	2	20
H. Eidelst. Ost	6	—	6	1	1	3
H. Schnelsen	10	—	10	4	—	4

From: *Handel und Schiffahrt, etc.*, pp. 184–5, 188–9.

From Hamburg itself three double-track lines lead towards Holstein and Denmark, Lübeck and Berlin (via Wittenberge); from

Harburg three double-track lines lead to Cuxhaven, Bremen and the Rhineland, and Berlin (via Stendal).

Waterway. The Elbe provides a waterway for 750-ton barges

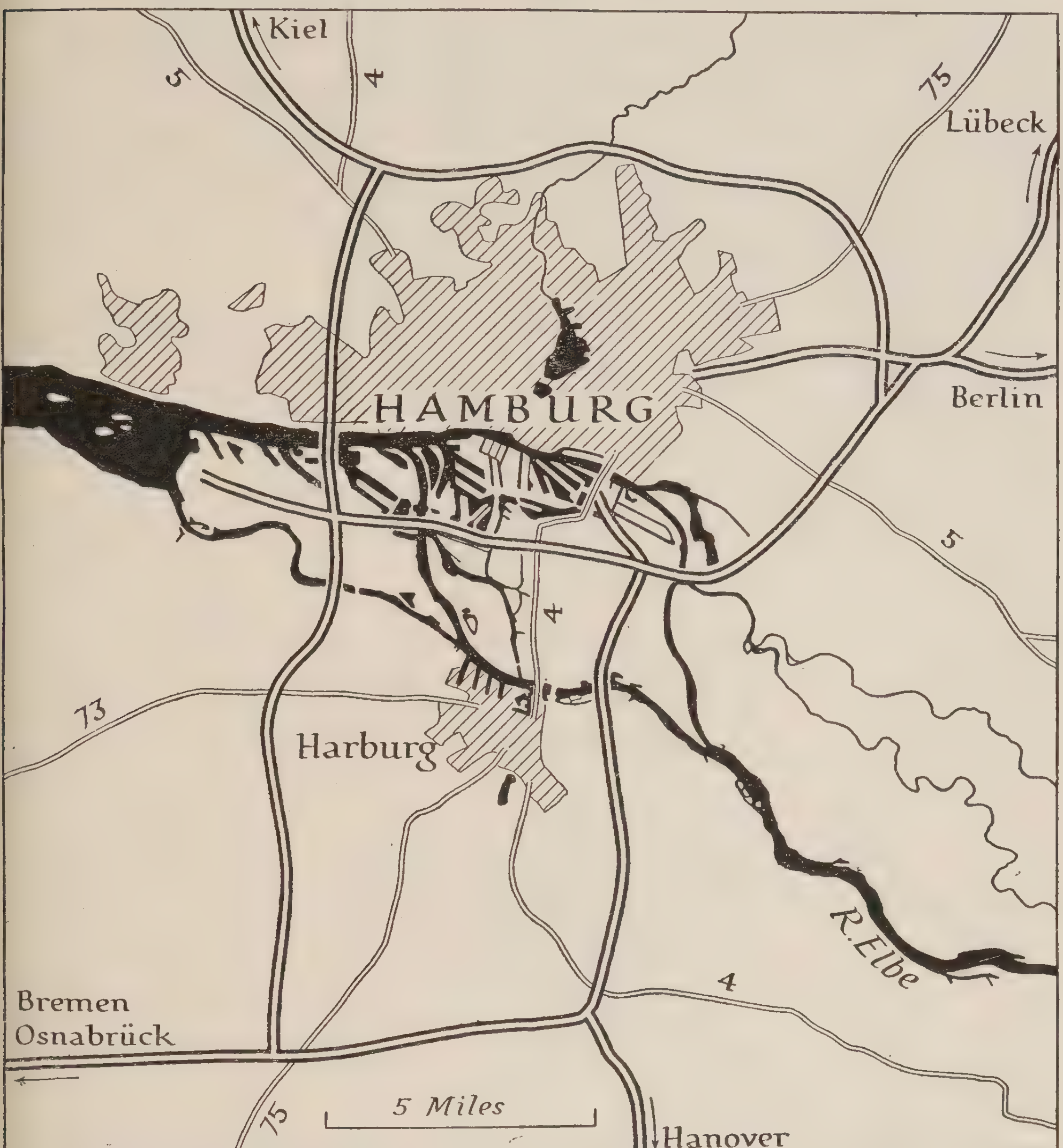

Fig. 27. Hamburg: the autobahnen plan

Based on *Fünf Jahre Arbeit an den Strassen Adolf Hitlers*, p. 14 (Generalinspektor für das deutsche Strassenwesen, Berlin, 1938).

The nature of the topography demands a more complicated lay-out than the ring which is commonly employed to connect a city with the autobahnen network. A large suspension bridge is planned for the more westerly crossing of the Norder Elbe at Altona. Less than half of the project has been completed. The numbers indicate the *Reichsstrassen* classification.

as far as the Czechoslovak frontier and for 600-ton barges as far as Prague. The hinterland for river traffic, therefore, extends far into central Europe and includes within Germany itself two of the

greater centres of population—Berlin and the industrial region stretching from Magdeburg to Saxony. Latitudinal canals extend the zone of waterway influence both westwards towards Hanover and the Ruhr (Mittelland C.) and eastwards beyond Berlin to the Oder (Mark waterways and Oder-Spree C.). The Mittelland C. operates, in some respects, to the disadvantage of Hamburg (see p. 97). An important project is the Hansa C., which would provide a direct connexion for large barges between the Ruhr and the Elbe estuary via the Weser at Bremen.

Roads. See Fig. 17.

For bibliographical note see p. 190.

Fig. 28. Hamburg: power stations, shipyards and oil refineries

Based on G.S.G.S. Series, Misc. No. 114.

S.P.L. St. Pauli landing stage; T.F. Köhlbrand train ferry. Power stations: 1 Neumühlen; 2 Altona-Bahnkraft; 3 Neuhof; 4 Tiefstack; 5 Überlandzentrale Harburg-Wilhelmsburg. Principal shipyards: S6 *Blohm und Voss*; S7 *Howaldtswerke A.G.*; S8 *Deutsche Werft* (Finkenwärder); S9 *Deutsche Werft* (Reiherstieg); S10 *H. C. Stülcken Sohn*; 11 Schiffsbau Versuchs Anstalt (shipbuilding research institute). Principal oil refineries: R12 Neuer Petroleumhafen; R13 *Rhenania Ossag* (Grasbrook); R14 *Norddeutsche Affinerie*; R15 *Rhenania Ossag* (Reiherstieg); R16 *Ebano Asphaltwerke A.G.*; R17 *Rhenania Ossag* (Harburg). The thick lines show the through railways (mostly two or more tracks).

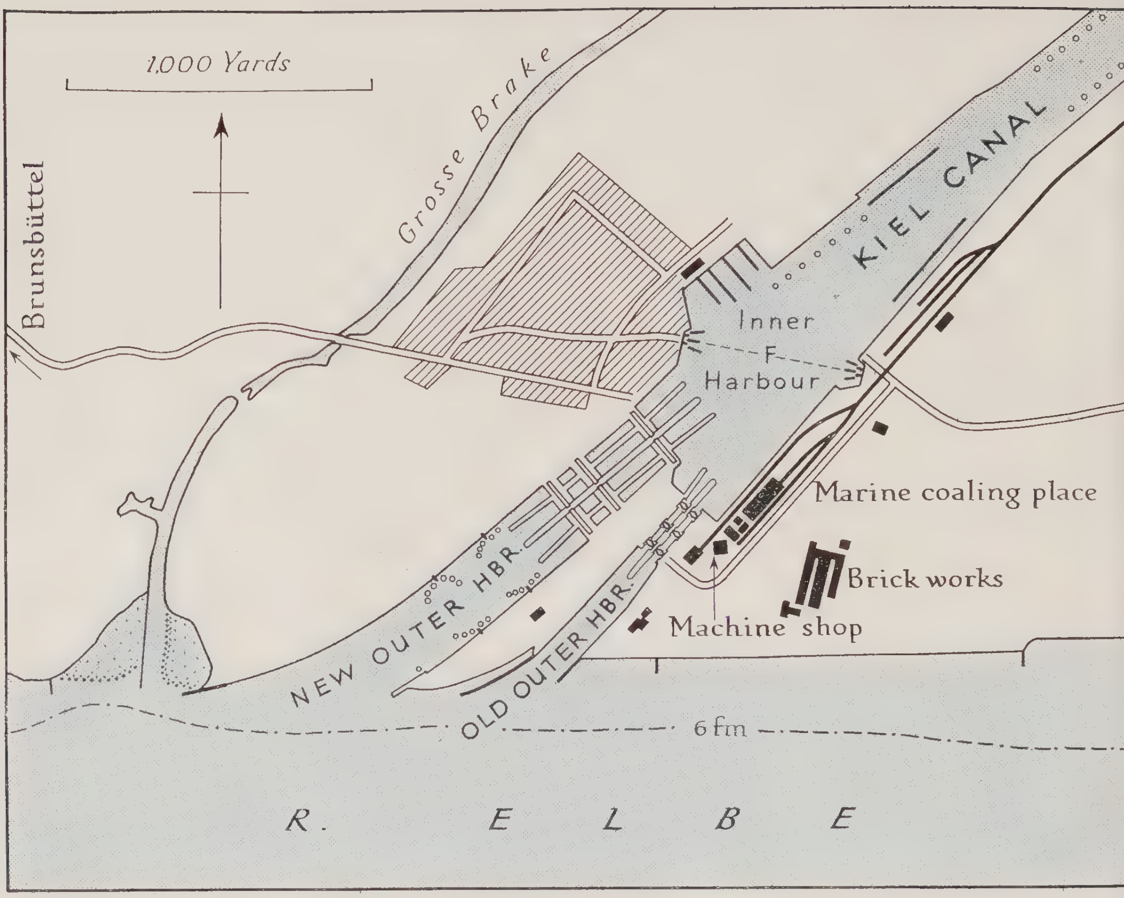

Fig. 29. Brunsbüttelkoog: North Sea entrance to the Kiel Canal
Based on official sources.
F Ferry.

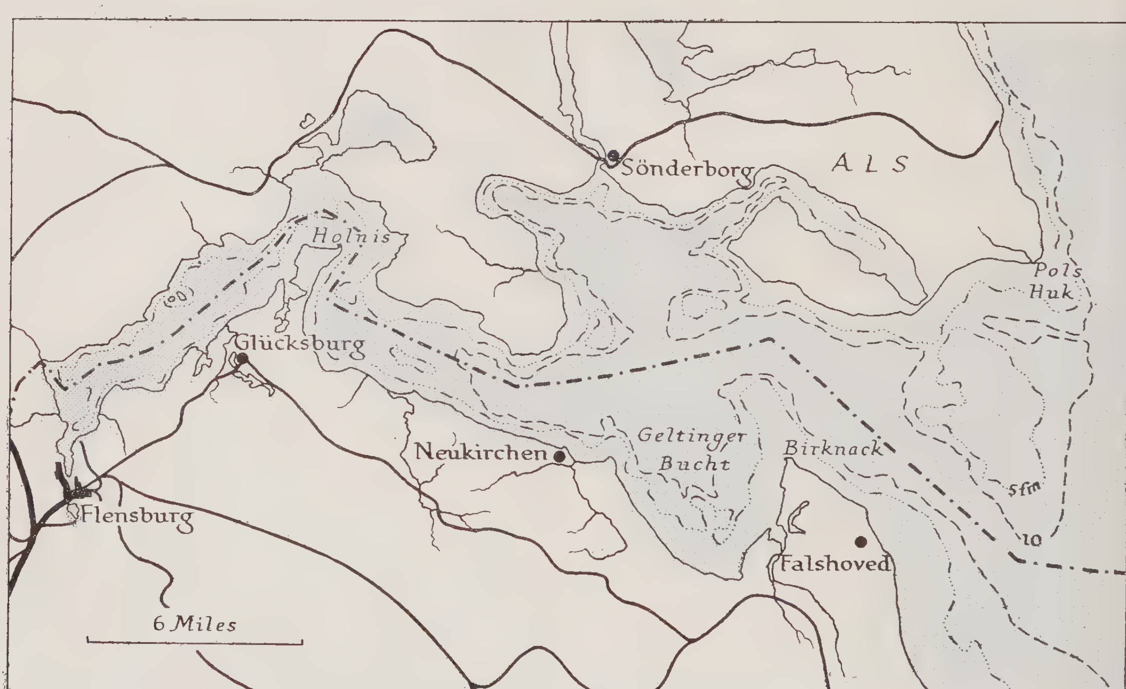

Fig. 30. Flensburg
Based on official sources.
Double-track railways are shown by a thick line and single-track by a thin line.

Chapter II

THE BALTIC PORTS

Introduction: The Kiel Canal: Flensburg: Kiel: Lübeck with Travemünde: Wismar: Rostock with Warnemünde: Stralsund: Sassnitz: Stettin with Swinemünde: Kolberg: Stolpmünde: Königsberg with Pillau and Elbing: War-time Conditions, 1939–44: Bibliographical Note

Introduction

In 1937, Germany's Baltic ports handled about 17·7 million tons of cargo, or considerably less than that of Hamburg alone (22 million tons). The outstanding Baltic port is Stettin, which handled about 8 million tons or almost half of the total; it is indeed the second port of the Reich by weight of cargo. Imports into the Baltic ports consist almost entirely of low-grade bulk goods, carried by short-sea cargo vessels; the three dominant items are coal from the Ems ports and Great Britain, iron-ore from Sweden, and timber mainly from Latvia, the U.S.S.R. and Finland. Exports represent little more than a third the weight of imports; they comprise grain, sugar, coal (largely re-exported, with the addition of some from Silesia to the coalless Baltic countries), and salt from the Lüneburg Heath. The imports of raw materials pass to the industrial areas of Berlin and Silesia, or are processed at the larger of the ports themselves. Most of the more valuable manufactured goods from the industrial areas, however, are exported through Hamburg.

The Baltic ports, in fact, suffered severely in the nineteenth century from the growth of Hamburg, and as a result have what might be described as a 'one-way hinterland'. The dredging of deep-water channels and the construction of the Kaiser Wilhelm (Kiel) C. only partially helped Lübeck and Stettin. A further blow was suffered in 1919, when, consequent upon the formation of an independent state of Poland, came the loss of Danzig, upsetting the balance of the German Baltic hinterland, and the remarkable growth of Gdynia. Gdynia's trade rose to 5·3 million tons in 1931, and Danzig's trade increased from 2·1 in 1913 to 8·3 million tons, while that of Stettin sank from 6·2 to 3·7 million tons in the same period. However, Germany's immense imports of iron ore and timber have helped since 1933 to raise Stettin's total beyond that of 1913.

The discrepancy between the North Sea and Baltic ports is much more marked if the net tonnage of shipping entered be considered; Stettin with 6·8 million net tons and Sassnitz with 5·1 millions compare unfavourably with Hamburg (39 millions), Bremen (12·8 millions) and Bremerhaven (5·7 millions). Passenger traffic in the Baltic is represented mainly by the train-ferry services to Denmark from Warnemünde and to Sweden from Sassnitz.

Detailed trade returns for the Baltic ports are grouped under six *Verkehrsbezirke* or 'traffic districts'. Stettin and Lübeck each constitute one of these, the remaining four consisting of groups of smaller ports within a particular administrative unit. The following table summarizes the trade returns of these traffic districts (in thousands of tons).

Traffic district	Chief ports	Imports		Exports		Total
		Coast-wise	Foreign	Coast-wise	Foreign	
1. East Prussian Ports	Königsberg Elbing Pillau	1,478·1	1,604·9	655·6	254·4	3,993
2. Stettin	Stettin	1,629·6	3,232·3	830·6	2,642·8	8,335·3
3. Other Pomeranian Ports	Sassnitz Stolpmünde Kolberg Stralsund Swinemünde	339·2	308·2	600·0	279·3	1,526·7
4. Ports in Mecklenburg	Rostock Warnemünde Wismar	114·1	299·5	95·7	199·1	708·4
5. Lübeck	Lübeck Travemünde	471·9	892·4	95·4	527·0	1,986·7
6. Baltic Ports of Schleswig-Holstein	Kiel Flensburg	422·8	473·5	245·4	61·7	1,203·4
Total trade at Baltic ports		4,455·7	6,810·8	2,522·7	3,964·3	17,763·5

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, *passim*.

The sixteen ports enumerated in this list are described in order from west to east. Twelve of them handled a total of over 100,000 tons of cargo in 1937; the remaining four are 'outports', and are described with their respective 'parent-ports'. Six other Baltic ports each handled over 50,000 tons of cargo—Heiligenhafen, Kappeln, Karlsminde, Lebbin, Neustadt and Rugenwalde (see p. 4).

Germany's Baltic coast-line shows a certain diversity in its outline. Into the embayments along the shores of the almost tideless sea flow

several large and a number of small silt-laden rivers; across their mouths wind-currents and drifts form spits and bars, damming up irregularly-shaped lagoons. The maintenance of dyked channels or ship-canals through the sand-spits and across the shallow embayments is therefore a vital and continuous task, especially when the main port lies up the river some distance from the open sea. In this case, the main port has an outport nearer the sea, used by vessels too large to negotiate the channel—Travemünde for Lübeck, Warnemünde for Rostock, Swinemünde for Stettin and Pillau for Königsberg. The best natural harbours are in the western Baltic, where there are several long straight-sided inlets, known as Förden; these have wide channels with depths exceeding 5 fm. to their heads, and offer easy approach and harbourage for shipping, as in the case of Kiel and Flensburg. Most of the Baltic ports consist essentially of dredged and regularized sections of main and subsidiary river channels, which have been partly quayed, with a number of basins which have free access to the channel. The construction and extension of these ports is not difficult, but constant dredging is essential.

Ice Conditions in the southern Baltic Sea

While navigation along the North Sea coast of Germany is seldom hampered by ice, the more severe climate and fresher water of the Baltic cause ice interference to be more frequent and serious. In hard winters ice, whether fast to the coast or drifting, may persist for as long as two months or more between the middle of January and the middle of April. It may become so thick as to hinder seriously or even prevent navigation along the southern Baltic coast; the chances of this are considered to be on an average about one year in five, although it is a striking fact that it happened in three consecutive recent years (1940–1–2). In ordinary winters there is no large area of fast ice, but in cold calm weather this sometimes extends a short distance from the coast, and persists until broken up by winds and currents. While many of the bights and partially enclosed waters freeze readily, especially the shallow brackish haffs, some of the river mouths remain ice-free longer because of the current, which helps the work of ice-breakers. The probable duration of fast-ice increases eastwards; while on an average Flensburger Förde and Fehmarn Sund are closed for three days each winter, the Stralsund channel has an average number of twenty-seven ice-fast days, and the Frisches Haff considerably more. These figures

are, of course, averages: Stralsund channel has been closed for as long as fifty-five days, but, on the other hand, it frequently remains ice-free. Ice rarely affects navigation in the open sea; it may form in the western Baltic for a few days, but seldom is it fast enough to stop navigation. Farther east and north, the liability to ice-closure increases, and the Gulf of Bothnia is blocked during most years. Thus while the Baltic iron-ore and timber trade usually ceases for some weeks, occasionally even months, the train ferries to Denmark and Sweden across the southern Baltic are rarely held up for more than a few days each winter.

The Baltic is very rarely cut off from the North Sea by the formation of ice. In the Sound, between Denmark and Sweden, ice in the fairways may become bad enough to impede navigation during about one winter in five. Formerly the ice remained unbroken for long periods, and could be crossed on foot, but now steamships and ice-breakers keep lanes open almost constantly, and it is seldom that the ice remains unbroken for more than a few days. Navigation in the Great Belt is frequently largely dependent on ice-breakers, while the narrower and shallower waters of the Little Belt are more liable to become entirely frozen over. The Kaiser Wilhelm (Kiel) C. is closed on an average for ten days; here, too, conditions vary considerably, for in 1929 it was closed for thirty-two days.

The liability to ice-closure of each of the main German Baltic ports is described in the appropriate section on 'Approach and Access' under each port. Ice-breakers keep them open longer than natural conditions would otherwise permit, in spite of the long fresh-water channels between the main harbours and their outports. In fact, as long as the coastal waters are free from ice, the ports are kept open.

The Kiel Canal

The Kaiser Wilhelm C., often called the Kiel C., or Nord-Ostsee C., connects the Elbe estuary at Brunsbüttelkoog and the harbour of Kiel at Holtenau. Constructed in 1887–95, its purpose was primarily strategic, in that its construction permitted units of the German navy to move freely between the North Sea and the Baltic without passing through the Sound. It plays a considerable part in the German coastwise and foreign trade, however, for the shortening of distance is considerable for vessels plying between German North Sea and Baltic ports, and permits small vessels to avoid the passage round the Skaw, which can be dangerous in rough weather. The

canal shortens the distance between Hamburg and the Baltic by 425 sea miles, and between London and the Baltic by 240. Plans were approved in 1939 for enlarging the locks and for widening and deepening the canal.

Fifty-three sea miles in length, it is a closed sea-level canal, for the North Sea end opens into tidal water. The greatest difference between the water levels at the two ends is 16 ft. Ships of the following maximum dimensions may be admitted: length, 1,033 ft; beam, 131 ft.; draught, 31 ft.; height of mast, 131 ft. At each end of the canal there are two large and two small locks of which only the larger locks are used by ships. These have a length of 1,083 ft.; a breadth of 148 ft.; and a depth in the entrance of 46 ft. (depth below the mean water level of the canal, which is about 1 ft. above the mean water level at Kiel). The new locks are closed by electrically-operated sliding caissons, and can be divided internally by a third sliding caisson into two compartments 650 ft. and 325 ft. long.

The Kiel C. can be navigated day and night, for it is illuminated by electric lamps on both sides for the entire length. The passage through the locks and the canal normally takes 7–8 hours; a speed of 8·1 knots must not be exceeded. Along the canal there are eleven recesses, of which four are turning basins. The radius of the sharpest bend is 5,904 ft., the surface width is 338 ft. and the bottom width 144 ft. All bridges cross the canal as high-level bridges, except one swing bridge. The canal is affected by ice for ten days in the average year—in the cold winter of 1929 it was closed for thirty-two days.

The canal has a separate administration, with headquarters at Hamburg and a sub-office at Kiel-Holtenau.

Status

The cost of building the Kiel C. was £7,800,000. Commercial traffic soon became considerable, and between 1895–6 and 1906 traffic passing annually increased from 1,500,000 tons to 6,000,000. Between 1905 and 1914 the bottom of the Kiel C. was doubled in width while the depth of the canal was increased to 36 ft. The cost of these improvements was £11,150,000. Von Tirpitz has pointed out in his *Memoirs* (vol. II, p. 356) that

> at the outbreak of war (1914) the Canal was not absolutely finished, the draught being in places too shallow. Damage was caused especially to the screws, hampering subsequent offensive operations—for in part it was not discovered until the ships were at sea—through loss of speed and excessive coal consumption.

The Treaty of Versailles (Articles 195 and 380–6) provided that the Kiel C. and its approaches were to be demilitarized and were to

be open on equal terms to the naval and mercantile vessels of all states with whom Germany was at peace. Tolls on the Kiel C. were to be the same for ships of all flags and the revenue collected from them was to be no higher than that required to maintain the waterway in good order. Germany was obliged to maintain the Canal in good condition for navigation. Minor disputes concerning the interpretation of the new regime were to be settled by a special German Court sitting at Kiel, while issues of major importance were to be referred to the Permanent Court of International Justice. One case brought before this Court deserves mention. In 1921 a French company chartered the *Wimbledon* to take munitions to Danzig for the Poles who were then at war with Soviet Russia. The German authorities refused to allow the vessel to pass through the Kiel C. on the ground that this would infringe Germany's neutrality in the Russo-Polish conflict. By a majority decision the Permanent Court laid it down that Germany should allow vessels carrying contraband of war to belligerent states to pass freely through the Kiel C. Under the Nazi regime the Kiel C. came again under purely German control.

Traffic

A heavy commercial traffic passes through the canal, accounted for mainly by three commodities—coal, ore and timber. In 1937, 53,000 vessels passed through the canal, with a net tonnage of 23,000,000; of this total 22,000,000 tons were accounted for by merchant ships. The cargoes were chiefly goods in bulk:

Bulk cargo passing through the Kiel Canal, 1934, 1937
(*in thousands of tons*)

	West–East		East–West	
	1934	1937	1934	1937
In German ships:				
Total	4,183	5,988	4,232	5,076
Timber	3	20	679	959
Cereals	243	610	1,134	537
Coal	2,414	3,156	570	974
Ores	20	116	1,243	2,038
In foreign ships:				
Total	1,659	3,816	3,301	7,189
Timber	1	4	578	1,923
Cereals	93	176	164	146
Coal	344	1,372	1,788	3,289
Ores	133	441	509	1,043
In all ships:				
Total	5,842	9,804	7,533	12,265

From: *Statistisches Jahrbuch, etc., 1938*, p. 230.

Thus in 1937, 22,069,000 tons of bulk cargo passed through the canal in both directions; the west-bound cargoes were considerably greater than east-bound cargoes. Coal provided the greatest weight —mainly German coal moving eastwards and Polish coal moving westwards.

Most of the traffic passing through the Kiel C. is 'short distance' traffic; the aggregate is enormous, and in 1937 exceeded the traffic passing through the Panama C.:

	Kiel C.	Suez C.	Panama C.
1935	17,197	24,673	19,656
1937	23,279	27,236	19,977

(in thousands of net tons)

From: *Statistisches Jahrbuch, etc., 1938*, p. 113.

Nearly half of the tonnage is German; the proportion fell from 57·1% in 1935 to 48·7% in 1937.

Hamburg derived certain commercial advantages from the building of the canal. This port, although interested mainly in the Atlantic and Pacific trades, served also as a link between the Baltic harbours on the one hand and the North Sea and Atlantic ports on the other. Before the Kiel C. was opened Hamburg's outgoing trade to Baltic ports amounted to 6·5% of her total trade. After the war of 1914–1918 outgoing trade to Baltic ports rose to 11% of the total trade, a development which took place, to some extent, at the expense of Stettin. Shortly after the opening of the Kiel C. it was found that grain from Russia was reaching Berlin by way of the canal and Hamburg instead of coming through Stettin.

Flensburg (Fig. 30; Plate 27)

54° 47′ N., 9° 26′ E. Population: 66,580 (1933); 67,000 (1938)

Flensburg, situated at the head of Flensburger Förde, is the most northerly port in German territory, the Danish frontier beginning at a point about 4 miles from the town on the north side of the Förde. Near Flensburg is the naval station of Mürwik.

Approach and Access

Flensburger Förde extends westwards from near the southern entrance to the Little Belt to the port at its head, a distance of 29 miles. It has several bends, and about halfway along it narrows abruptly. To the east of this is the outer Förde, nearly 10 miles wide,

with depths generally exceeding 10 fm. The inner Förde maintains a width of 2 miles almost to the Hafen at its head, and depths vary from 5 to 10 fm. Flensburger Hafen is a narrow inlet about a mile long and a quarter of a mile wide. There are numerous banks and shoals in the Förde. The fairway is broad and relatively uncomplicated as far as Holnis narrows, the channel between Holnis Haken and the Danish coast. Here, however, is the narrowest and most difficult passage for large vessels in the whole Förde. There is a width of only 100 yds. between the 5-fm. lines between Schidenkind and Dalsgaard Grund, and the channel turns sharply round the north-western extremity of the former bank. Beyond the Holnis channel the fairway widens, with a uniform depth of about 8 fm. to a point about a mile north of the entrance to the Hafen, where the depth decreases, and several shoals with depths under 3 fm. narrow the fairway between them and the eastern shore.

The outer Förde affords anchorage for vessels of any size, but the sea raised by northerly winds renders it uncomfortable for small vessels.

A number of villages along the Danish shore of the Förde have small piers, but they are of little importance. The main anchorage, used by large vessels unable to enter Flensburger Hafen, is Flensburg road, situated north-east of Mittelgrund, a shoal patch near the entrance to the Hafen. The anchorage, which has depths of 6½ to 10 fm., is open to north-easterly winds, which raise a considerable sea. Vessels of more than 20 ft. draught proceeding through the inner Förde above Holnis, usually employ a pilot, both on account of narrowness of the channel and because there are frequent variations in depths owing to the influence of the wind. Pilotage is compulsory for all foreign merchant vessels of over 400 cubic metres capacity proceeding to or from German places within the Förde.

Ice may form in the Förde in the middle of January and break up about the middle of March. The number of days during which the Förde was completely closed to shipping during a ten-winter period of observation was, however, only three; the maximum was twenty-one. Should easterly winds set in during the period of break-up the ice may be driven back, forming barriers across the narrow parts of the Förde, notably off Holnis.

Detailed Description

The port of Flensburg consists of quays along the eastern and western shores of the Hafen at the head of the Förde, together with

Plate 21. The cruiser *Leipzig* passing through the Kiel Canal
This picture was taken near Rendsburg, in 1935.

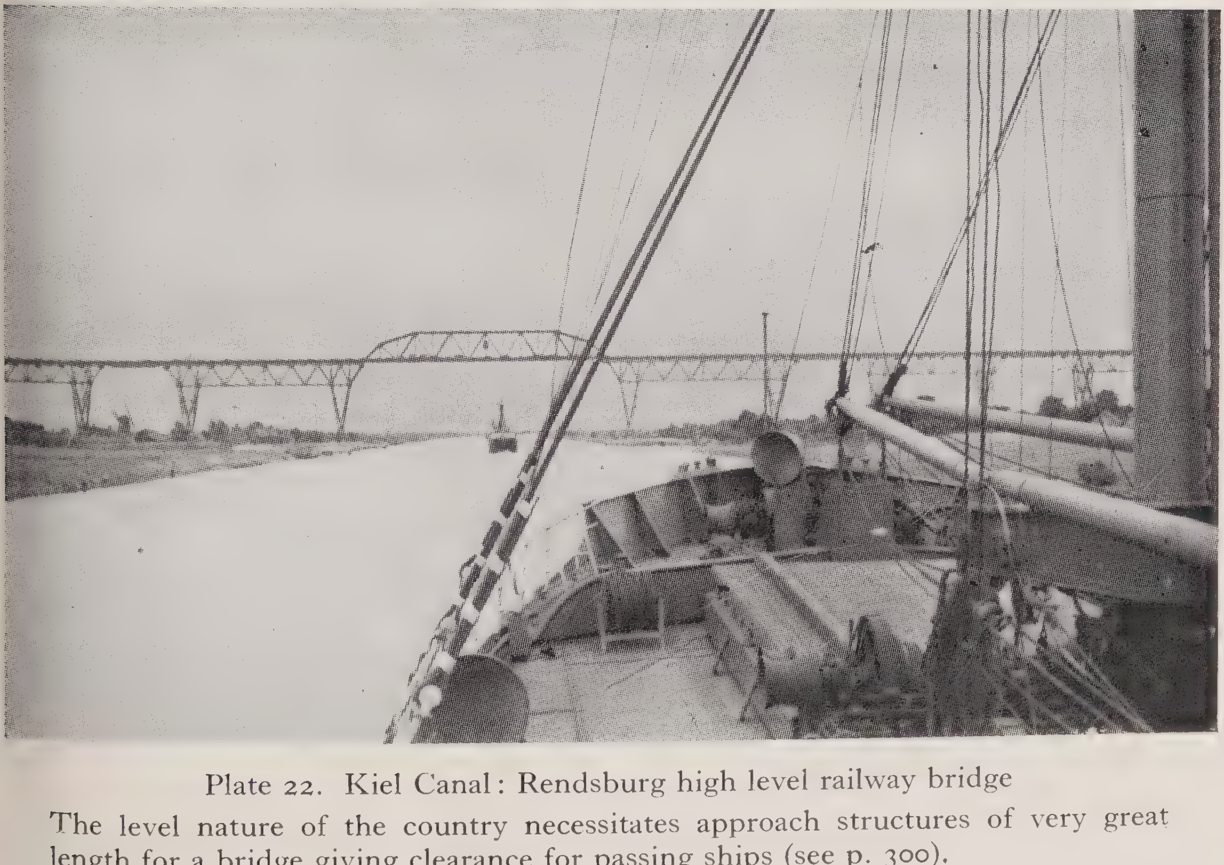

Plate 22. Kiel Canal: Rendsburg high level railway bridge
The level nature of the country necessitates approach structures of very great length for a bridge giving clearance for passing ships (see p. 300).

Plate 23. Kiel-Holtenau: Baltic entrance to Kiel Canal, looking east-south-east
Each of the two main locks is divisible internally by a third gate. To the left of the locks lie the old locks, one of which is used as a dry dock. In the centre background is Admiral Scheer Hafen, in the right background Tirpitz Mole.

Plate 24. Kiel-Wik: Tirpitz Mole, looking south-east
The near shore on the right is Düsternbrook. The distant shore is the eastern side of Kieler Förd; a hammerhead and gantry at *Deutsche Werke*, Nord Werft, Dietrichsdorf, can be distinguished.

the Free Port basin on the eastern shore of the Hafen. The eastern quays have a total length of 1,800 ft., with depths of 21–23 ft. alongside; the western quays have a total length of 1,600 ft., with depths of 13–23 ft. alongside. Large timber-laden sailing vessels usually lie with their heads to the wharves and their sterns made fast to buoys. Vessels unable to approach the wharves make fast to buoys.

The Free Port consists of a basin open to the northward about 1,540 ft. long and 230 ft. wide, with a total length of quays of 3,280 ft., and with depths alongside of 18 ft. West of the basin, in the Hafen itself, is a quay 1,480 ft. long, a part of the Free Port, with depths of 23–25 ft. alongside.

On the eastern shore of the Inner Förde, about ¾ mile north of the Free Port, is the naval station of Mürwik. It has a northern pier, forming a small boat harbour, which is unsuitable for berthing; a central iron pier with concrete extensions forming a small torpedo-boat harbour with depths of 5–7 fm. alongside; and a southern steamer pier with depths of 21–33 ft. alongside.

Port Facilities

No details are available of the storage accommodation at the port; there are several large warehouses, including a granary, behind the east quays and round the Free Port basin. There are small sheds and stacking space for coal on the west quay.

The shipyards of the *Flensburger Schiffsbau-Gesellschaft* are situated on the western side of the Hafen; the new yard is just to the north of its entrance, the old yard to the south within the Hafen. There are four floating docks at the old yard; one of these is 280 ft. in length and 49 ft. wide at the entrance, with a lifting power of 2,200 tons. With the help of pontoons, this dock can take a vessel 250 ft. in length. In October 1941 a floating dock 300 ft. long was under construction. The new yard has four slips, 600–700 ft. long. The yards are well equipped with workshops. The largest merchant vessel built was of 9,000 tons. A second shipbuilding company, *H. J. Petersen Schiffswerft*, is situated outside the Hafen on the east shore between the Free Port and the Mürwik naval station. It has a patent slip to take vessels up to 110 ft. long.

The Free Port quay alongside the Hafen has two cranes, of 3 and 2 tons capacity. On the west quays are sheers of 100 and 35 tons respectively, a 100-ton crane, a 6-ton crane, four grabs of 4 tons each, and two grabs of 3 tons each.

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On the eastern shore of the Inner Förde, about $\frac{3}{4}$ mile north of the Free Port, is the naval station of Mürwik. It has a northern pier, forming a small boat harbour, which is unsuitable for berthing; a central iron pier with concrete extensions forming a small torpedo-boat harbour with depths of 5–7 fm. alongside; and a southern steamer pier with depths of 21–33 ft. alongside.

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Trade

The following figures summarize the trade of Flensburg for 1936 and 1937, the latest years for which statistics are available.

	Coastwise		Foreign		Total
	Outwards	Inwards	Exports	Imports	
1937	19·7	87·1	30·4	121·6	258·8
1937	14·9	89·0	40·4	124·4	268·7

From: *Die Seeschiffahrt im Jahre, 1937*, Heft I, p. 4.

No detailed figures are available of the trade of Flensburg, as its returns are included in those of the 'Baltic ports of Schleswig-Holstein' traffic district (see p. 108). Imports consist mainly of coal, brought from Great Britain and coastwise from the Ems ports, sawn timber from Latvia and Finland, maize and other grain. Exports, which are much less important than imports, include stone, lignite, briquettes, oilcake, wheat, sand and gravel.

Industries

The main industrial importance of Flensburg lies in its shipyards, the most important of which is the *Flensburger Schiffsbau-Gesellschaft* (see p. 113), and builds merchant ships of considerable size. There is also the small *H. J. Petersen Schiffswerft*. Minor industrial concerns comprise a paper factory, a brewery, a cement works, and a large abattoir.

Communications

Railways. Flensburg is served by three railway stations; the old station lies immediately south of the head of the Hafen, the main station, with the goods station and sheds, is about $\frac{3}{4}$ mile farther south, and a branch station is situated east of the head of the Hafen. From the old station a line runs north along the west quay, with its terminus at the *Flensburger Schiffsbau*; another, with numerous sidings and branches, serves the main east quays and the Free Port basin.

From the main railway station, a short double-track line leads to a triangular junction with the main line running from north to south through east-central Schleswig-Holstein. Northwards it leads to Kolding and Fredericia in Denmark, southwards to Schleswig, Rendsburg and Neumünster; from the last-named junction, lines

run north-east to Kiel, south-east to Lübeck and south-west to Hamburg. A single-track line runs south-east from the Flensburg branch station to Eckernförde and Kiel, and another runs west across the peninsula to Lindholm from Weiche, a small junction on the main line south of Flensburg. A narrow-gauge line runs eastward from the Flensburg branch station along the southern shore of Flensburger Förde to Glücksburg and Kappeln.

Inland waterways. None.

Roads. See Fig. 17.

KIEL (Fig. 31; Plates 25, 26)

54° 20′ N., 10° 08′ E. Population: 272,000 (1939)

Kiel is the chief German naval base in the Baltic, deriving considerable importance from its position near the entrance to the Kiel (Kaiser-Wilhelm) C. It is the site of a naval arsenal and dockyard, the seat of several naval commands, and a centre for merchant shipbuilding of some importance. As a commercial port it is of some account, although it handles much less cargo than Stettin, Königsberg and Lübeck. The town lies on the west side of the harbour.

Approach and Access

From the Baltic the wide Kiel Bay narrows to a width of $\frac{1}{2}$–1 mile in the more restricted Kiel Förde, which in turn narrows southwards of the canal entrance, and is known as Kiel Harbour. The entrance has a depth of 9 fm. in the middle of the fairway; off Friedrichsort light at the entrance to the Förde the fairway has a least width of 250 yds. From the North Sea, approach by the Kiel C. can be made by ships of the following maximum dimensions; length 1,033 ft., beam 131 ft., draught 31 ft., height of mast 131 ft. The passage through the canal (53 sea miles) averages 9 hours, including passage through the locks.

The tidal range is nil. The water level is affected by sustained and strong winds. Winds between north and east raise the level by about 5 ft., while winds between south-west and south lower it by about 3 ft. As the harbour is land-locked, berthing and handling are unaffected by weather. As a rule the harbour is not ice-bound, and a channel through the Förde for the Kiel-Korsör packet can be maintained by ice-breakers. In severe winters, however, the harbour entrance, the harbour, and the canal may become blocked by ice.

Anchorage may be found off Friedrichsort in $3\frac{3}{4}$ to $5\frac{3}{4}$ fm., in Holtenau Roads in $6\frac{1}{2}$ to 7 fm., and in Heikendorfer Bucht in 5 to $6\frac{1}{2}$ fm.

Detailed Description

On the north-west side of the harbour a few jetties are situated at Friedrichsort and Vossbrook, north of the canal entrance. Besides a seaplane base, various minor naval facilities are found. At Friedrichsort is the *Deutsche Werke A.G.* munitions plant.

Holtenau. The old locks of the Kiel C. are no longer used for the passage of sea-going ships, although the southern lock of the two is used as a dry dock. The new locks have a length of 1,082 ft., a width of $147\frac{1}{2}$ ft., and a depth of $46\frac{1}{4}$ ft. (below the mean water level of the canal, which is about 1 ft. above the mean level at Kiel). Inside the lock are Holtenauer Binnenhafen and Kieler Nord Hafen, widened stretches with quays, used for commercial purposes such as bunkering.

South of the canal entrance, at Kiel-Wik, is a commercial basin, Admiral Scheer Hafen, with north and south moles; depths in the basin are 32 ft. South of this section of the port lies Wik Hafen (Tirpitz Hafen), protected by a mole. Depths within are considerable in parts. Within the basin there are several jetties.

Farther to the south, apart from jetties for small vessels, there is the Blücher Jetty, alongside which a light cruiser can berth. A further succession of small piers and jetties follows along the frontage of the town. By the Schloss the final narrowing of the harbour begins, and for the remaining mile it has a mean width of 750 ft. in the outer part, and 400 ft. in the inner part, with depths of 5–6 fm. and $3\frac{1}{2}$–$4\frac{1}{2}$ fm. respectively. This inner harbour, formerly known as Handelshafen, is now called Innenhafen. The western quays and piers, together with the quays at the head of the harbour are used by merchant shipping, such as the Korsör packet and the lines from Oslo, Gothenburg, Stettin and Königsberg.

Eastern side of Harbour. It is on the eastern side of the harbour that the bulk of the shipbuilding and engineering sites are found. First, on the opposite side of the Innenhafen, stand the slips and shops of *Krupp Germania Werft.* Next follows the long frontage of the *Deutsche Werke, Süd Werft,* with dry docks, floating docks and fitting-out berths. Behind lie two basins—Werft Innenhafen (Ausrüstungs Bassin) and Bauhafen.

Immediately to the north-east lies the Marine Arsenal, extending to the south bank of the Schwentine river. The long Arsenal

Details of Quayage at Kiel

	Depth below chart datum, ft.	Length, ft.	No. of quay cranes	Other cranes
Friedrichsort:				
Deutsche Werke Brücke (1)	12–15	520		
Vossbrook:				
W. and S. quays (2)	21	800		
Holtenau:				
Aussenhafen (3)	14½	920		
Kieler Nordhafen (4)	26	1,650	4	2 grain elevators
Binnenhafen (5)	31	2,620	2	
Betriebshafen (6)	? 20	530		
Admiral Scheer Hafen:				
North Mole, S. side (7)	30	980		
Mittel Brücke, two sides (8)	30–15	980		
South Mole: N. side (9)	30	980	4	
S. side	30	450	5	
Tirpitz Hafen:				
Tirpitz Mole: outer side (10)	15	1,350		
	24	380		
inner side	? 15	1,400		
Scharnhorst Brücke (11)	30	620		
South Mole: inner side (12)	? 30	1,650		
outer side	? 30	1,650		
Düsternbrook:				
Blücher Brücke, outer side (13)	20–26	850		
Innenhafen:	? 16–20	5,420	6	2 elevators
Germania Werft:				
South quay (14)	27½	1,500	3	1 150-ton hammerhead
Deutsche Werke, Süd Werft:				
South quay (15)	44	850	2	
Aussenhafen: shore quay	31	1,125	3	
other	14½	750		
Aussen Mole		1,970		
Werft Innenhafen: various quays (16)	33½	4,775	6	
Bau Hafen: various quays (17)	32	2,805	4	
Marine Arsenal:				
Shore quay (18)	34½	1,850		1 40-ton hammerhead
North end		1,100*		
Arsenal mole: inner side (19)	34½	1,800*		
outer side	33	1,400	3	
Deutsche Werke, Nord Werft:				
Offset wharf	26	450		
Quay	? 20, 26	920	1	
South mole, north side	?	720		
Middle jetty, south side	28½	350		
Ausrüstungs Bassin: (20)		2,550*	1	1 150-ton travelling hammerhead

* Total.

The figures in brackets refer to the numbers given to the quays, etc., in Fig. 31.

mole encloses the extensive Arsenal Hafen, in which depths are 34 ft.

The Schwentine river is navigable for about ¾ mile, with depths of 13 ft. Along the south bank in the lower reach are a fishing harbour and a torpedo store. The north bank of the Schwentine river is partly taken up by the shipyard of *Deutsche Werke, Nord Werft* (formerly *Howaldtswerke*), which has its main frontage on Kiel Harbour.

Beyond the yard, in the districts of Dietrichsdorf and Mönkeberg, lie, in succession, a naval munitions depot, a victualling depot and oil storage.

Over the entire port the length of quayage is very considerable, distributed among many moles, piers and jetties as well as quays. The total berthing accommodation is as follows (including berths alongside in shipbuilding and repairing yards):

Length, ft.	Depth, ft.	No. of berths
600	30	20
450	26	27
450	20	5
350	20	6
250	16	32
200	12	30

The details of the principal quays may be summarized as in the table on page 117.

The Dietrichsdorf Munitions Depot, the Victualling Depot, the Mönkeberg Oil Depot and the Korügen frontage possess several thousand feet of quayage, with various depths alongside, mostly moderate, and equipped with 17 small cranes. At the Mönkeberg Oil Depot the outer half of the south pier provides 600 ft. of quayage with depths alongside of 25–33 ft.

Port Facilities

There are seven dry docks at Kiel. Four are in use at *Deutsche Werke, Süd Werft* and one at Holtenau. The lengths of the four are: 397 ft., 431 ft., 659½ ft., 735 ft., and of the Holtenau dock—492 ft. There are two dry docks at the *Süd Werft*—356½ ft. and 304 ft. long: these appear not to be in use. There are 19 floating docks, of which the longest (two) are 525 ft. long; 14 are below 400 ft. Many have been sunk or destroyed.

The *Deutsche Werke, Kiel A.G. Süd Werft* includes three slips—850 ft., 660 ft., and 1,000 ft. Warships built in this yard include the *Gneisenau* (26,000 tons). Merchant ships up to 9,000 tons have also

been built. Both turbine and reciprocating machinery can be constructed.

Deutsche Werke, Kiel A.G., Nord Werft (formerly *Howaldtswerke*) has six building slips (one of 550 ft., two of 500 ft., and three of 425 ft.). Warships have not been built in this yard since 1920. Every type of merchant vessel has been turned out, however; recent construction in peace-time has involved mainly ships up to 1,200 tons, although tankers up to 8,000 tons have been built. Work has also included two 40,000-ton floating docks. The yard has also constructed steam and diesel-engines for hulls built elsewhere. This company has a very complete equipment for engineering work associated with shipbuilding. Parts for ships and floating docks are finished almost entirely at the works; engines, pumps and accessories are also made, and in peace-time steel castings and forgings were supplied to other shipyards and engineering works.

F. Krupp A.G. Germania Werft has eight building slips, of which four are covered. The longest of the covered slips is 820 ft. Recent war-time construction included the *Prinz Eugen* (10,000 tons); the yard has built merchant ships up to 12,000 tons. Both diesel-engines and turbines can be constructed. Most of the ships built in this yard are fitted with engines constructed in the shops. After the war of 1914–1918 the company greatly developed its workshops, so as to produce stationary machinery of every description, marine and locomotive diesel-engines, steam turbines, and water-tube boilers (in which it specializes).

Bomb damage to both the town and shipyards has been very severe and much of both areas will have to be rebuilt.

The Town

Since 1906, when its population overtook that of Altona, Kiel has been the largest city in Schleswig-Holstein. It became part of Prussia in 1866, and since then has developed rapidly, not only as a great naval base, but also as a centre of shipbuilding, industry and commerce.

Kiel—i.e. Kyle or 'on the bay'—lies, not at the open sea, but some 10 miles away at the southern end of the sheltered wooded Kieler Förde. The original settlement at Kiel in the first half of the thirteenth century was on a peninsula on the west bank of the inlet. To-day the Kleiner Kiel lake divides the old town from the modern suburbs. Notable buildings in (or near) the inner town include the old Town Hall, the *Nikolai Kirche* (restored 1877–84), the sixteenth-

century castle (restored 1838) and the modern buildings of the University (erected in 1876 at the northern end of the Castle Gardens).

Little urban expansion of any significance occurred until the second half of the nineteenth and the early years of the twentieth century. Then the town expanded northwards along both sides of the Förde—on the left bank to Düsternbrook and then along either side of the Holtenauerstrasse to Wik and Holtenau (Kiel C.); and on the right bank to Ellerbek, Wellingdorf and across the estuary of the river Schwentine to Neumühlen-Dietrichsdorf. The districts on either side of the Schwentine river are linked by the road bridge on the Schönberger Strasse. On the whole the new districts on the western shore of the Förde are residential in character, while those on the eastern shore are industrial areas. Southwards there has been some urban development inland along the main roads—the Rendsburg Landstrasse, the Hamburger Chaussee, and the Preetzer Chaussee—as well as along the railway to Lübeck and Hamburg.

Kiel, a municipal borough (*Stadtkreis*) 22 sq. miles in area, has administrative functions in the Reich and in Prussia. In the Reich Kiel is a centre for the administration of naval and military matters, the post office (*Oberpostdirektion*), finance (*Finanzamt*) and customs (*Hauptzollamt*) and the seat of a branch office for the Kiel C. (*Reichskanalamt*). Kiel has a Court of Appeal.

In Prussia Kiel has been since 1917 the seat of the administration of Schleswig-Holstein. This province was reduced in size after the war of 1914–1918 as the result of a plebiscite held in accordance with the terms of the Treaty of Versailles. Schleswig north of the Flensburger Förde fell to Denmark. The province now has an area of 6,050 sq. miles and a population of 1,420,000. Many provincial (local government) services—e.g. police administration (*Polizeipräsidium*)—have their headquarters in Kiel. The town is the seat of a Protestant Bishop. Kiel is a centre of learning and culture, with a University (1665), an Engineering College, a teachers' training college, various trade schools and secondary schools, the *Institut für Weltwirtschaft* (1914) and a Research Institute in Dairy Farming. The most important museums are the Museum of Germanic Antiquities and the Thaulow Museum.

History

Kiel was founded in the thirteenth century by the Counts of Holstein. The town soon gained municipal rights and became a member of the Hanseatic League. In the second half of the fifteenth

Fig. 31. Kiel

Based on official sources.

C.B.Q., O.B.Q. Coal, oil bunkering quays. The numbers correspond to the numbers given to quays, etc., on p. 117.

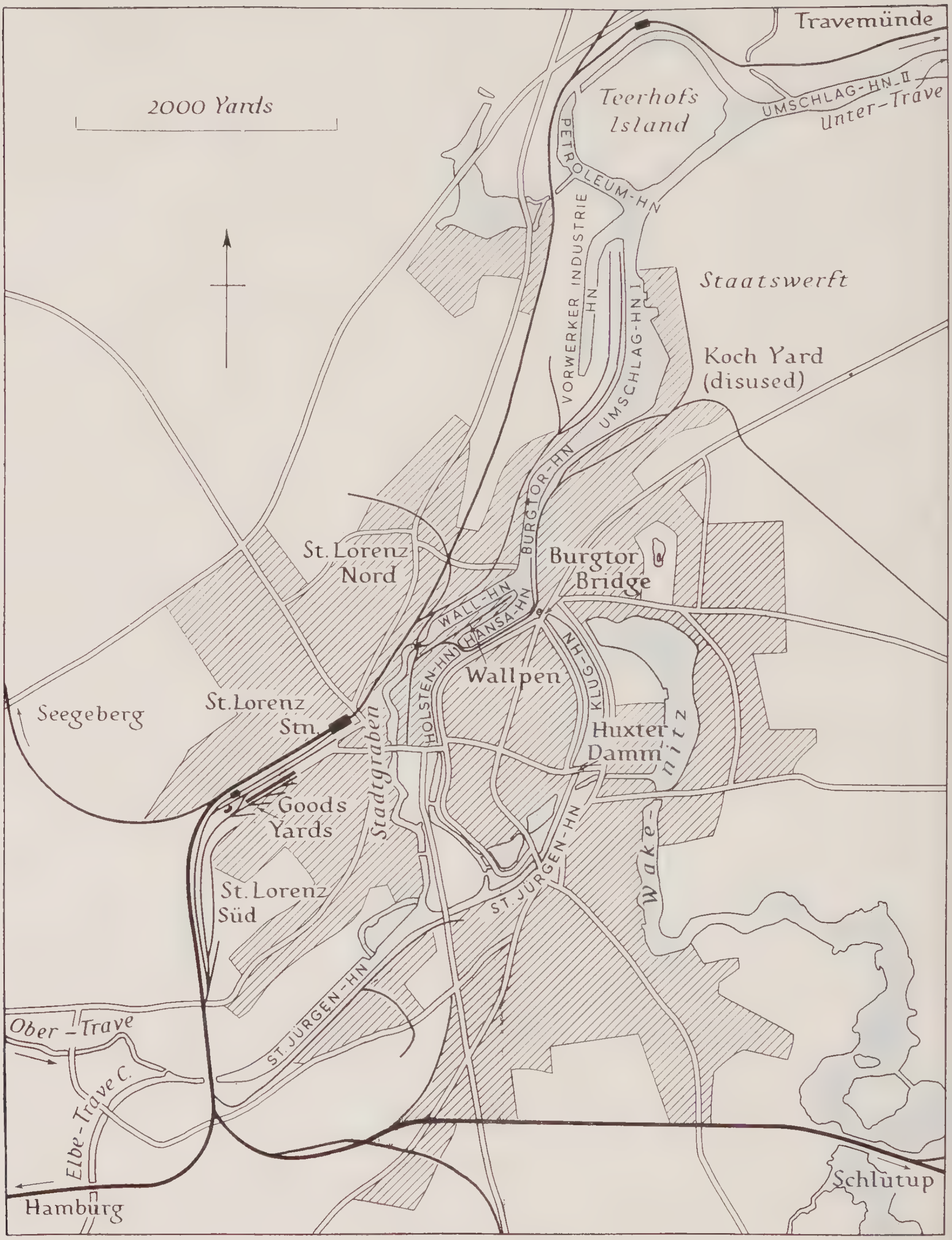

Fig. 32. Lübeck

Based on G.S.G.S. Series 4480.

The old city is the closely built-up area covering the island between Klug-Hafen and Holsten-Hafen.

century a money market was held in Kiel every year from 6 January to 13 January (the *Kieler Umschlag*) and it became of some importance in the commercial affairs of Denmark and northern Germany. The rulers of Holstein hoped that Kiel might rival Lübeck as a centre of Baltic shipping and trade, but they were disappointed. Kiel's commerce remained on a modest scale and when the Hanseatic League declined in the sixteenth century the trade of the port also declined.

Between 1721 and 1773 the Dukes of Holstein-Gottorp had their residence in Kiel. The hold of the Danish kings over the Duchies of Schleswig and Holstein gradually increased, and by the eighteenth century they were, for practical purposes, virtually in complete control. In the nineteenth century Danish and German nationalism clashed on the Schleswig-Holstein question. The Duchies were largely German in population, and Holstein (though not Schleswig) was included in the Germanic Confederation of 1815. But the Danish kings had old-established rights in the Duchies and the Danish nationalists wished to incorporate the Duchies completely. In 1849–51 the Duchies rose against Denmark—Kiel being the seat of the *Statthalterschaft*—but they failed to secure their independence. In 1863 Christian IX, who had just come to the Danish throne, agreed to a unitary constitution which incorporated Schleswig fully within Denmark and left Holstein with a separate administration. There was great indignation in Germany and much support for the claims of Duke Frederick of Augustenburg to the Duchies. Bismarck skilfully took advantage of the situation to secure the Duchies—including the fine harbour of Kiel—for Prussia. Austria and Prussia together made war upon Denmark and took Schleswig and Holstein from her (1864). After a brief period during which Schleswig-Holstein was ruled jointly by Austria and Prussia it was arranged—by the Treaty of Gastein (1865)—that Prussia should administer Schleswig while Austria governed Holstein. But Kiel harbour came under Prussian control. After the Seven Weeks War (1866) both Schleswig and Holstein were seized by Prussia. They were absorbed into the Prussian customs system (and so into the Zollverein) in the following year.

The old commercial links between Kiel and Denmark were thus broken, but the city was amply compensated since it developed rapidly as a Prussian town. Communications were improved. As early as the forties Kiel had been joined by rail to Altona (via Hamburg) and thus soon became linked with the main German lines.

Now the harbours at Kiel were greatly extended and a new one was built both by the State and private enterprise. In 1895 the Kiel C. was opened. The port made rapid progress as Germany's Baltic naval base. The most important yards were the *Kriegsmarinewerft*, the *F. Krupp Germaniawerft*, the *Deutsche Werft* and the *Howaldtswerke*. To old-established industries such as milling and timber were added new manufactures such as machine-building, electro-technical work and fish-curing (*Kieler Sprotten*).

The population of Kiel increased as follows:

1860	20,000	1890	70,000	1925	213,800
1871	32,000	1900	112,000	1932	220,000
1880	44,000	1910	226,000	1938	244,300
		1918	245,000		

When Germany was defeated in the war of 1914–1918 the naval mutiny at Kiel (see vol. II of this Handbook, p. 233) was a signal for the outbreak of revolution in many cities in the Reich. The German navy was surrendered and the Treaty of Versailles drastically limited the size of the new fleet. So Kiel for a time lost much of its former importance and her industries—hitherto largely dependent upon the navy—suffered greatly.

Attempts were made to extend commercial activities. In 1921 a trade fair called the *Nordische Messe* was established, and in 1924 a large new Free Port was opened at Wik. Existing harbour facilities were greatly improved. To attract visitors in the summer the regattas (*Kieler Woche*) were revived, but they lacked the splendour of those held before 1914. In 1930 the number of ships arriving at Kiel was 5,433 (of 1,277,100 tons). Imports from overseas in that year amounted to 630,000 tons and exports to 115,800 tons.

When, under the Nazi regime, a new German fleet was built, Kiel revived as a naval base and as a shipbuilding centre. In 1938, for example, the *Deutsche Werke* launched the 19,250-ton aircraft carrier *Graf Zeppelin*, the *F. Krupp Germaniawerft* had an output of six vessels of 24,395 tons and the engineering works of the *Germaniawerft* constructed marine engines of 150,000 h.p.

Trade

The trade of Kiel is not described in detail in the German returns of port traffic. The total trade is summarized in the table on page 123.

Cargoes comprise chiefly coal, liquid fuels, raw materials and foodstuffs. Kiel lies too near Hamburg to have developed any extensive trade in general merchandise or tropical produce. Such cargoes are dispatched by rail from Hamburg.

Trade in 1936, 1937 (*thousands of tons*)

	Total	Coastwise		Foreign	
		Outwards	Inwards	Outwards	Inwards
1936	547·4	29·0	233·6	21·9	262·8
1937	638·6	50·5	279·2	18·7	290·2

From: *Die Seeschiffahrt im Jahre 1937*, etc., Heft I, p. 4.

Industry

Industries are but little developed, beyond the activities of the shipyards and arsenal. There are several firms manufacturing navigational and naval instruments; for certain types of apparatus they are the leading suppliers in Germany. A flour mill has a capacity of 100 tons per day.

Communications

Rail. Single-track lines lead westwards to Rendsburg and Eckernförde; a double-track line leads southwards to Hamburg via Neumünster. Lübeck can be reached by this line or by two single-track lines.

Waterway. Although the Kiel C. provides waterway connexion with the Elbe estuary, barge traffic is of no great importance. Traffic amounted to about 100,000 tons in 1937, mostly inwards.

Roads. See Fig. 17.

Lübeck with Travemünde (Fig. 32; Plate 28)

Lübeck 53° 54′ N., 10° 42′ E. Population (including Travemünde): 133,021 (1933); 147,000 (1938)
Travemünde 53° 58′ N., 10° 53′ E.

Lübeck lies on the banks of the river Trave about 11 miles from Travemünde, its outport at the mouth of the river. Formerly Germany's greatest Baltic port, and, indeed, at one time the leading member of the Hanse, it has suffered a considerable relative decline in recent centuries. This decline has been due partly to the dominance of Hamburg, partly to the growth of Stettin, and partly to the difficulty of access along the Trave.

Approach and Access

The river Trave flows into Lübecker Bucht, a large rectangular

bay in the western Baltic. Most of the bay has uniform depths of 12 fm., decreasing to 5 fm. at the entrance to the Trave channel. The only bank in the bay is Walkyrien Grund, about 3 miles from the northern shore, which has a least depth of $3\frac{1}{2}$ fm. There is anchorage in the roads outside the river entrance in depths of 9 fm. This is, however, exposed to north-easterly and east-north-easterly winds, but a vessel with good anchor gear should be able to ride out a gale.

The entrance to the river Trave is approached by a dredged channel, marked by light-buoys, with a width of 295 ft. and a depth of 31 ft. The entrance channel has a navigable width of 344 ft., and is entered between two short stone moles. The harbour of Travemünde extends from the north mole head for a distance of about a mile upstream.

The river Trave follows a winding course between Lübeck and Travemünde, at times widening to form shallower sheets of water, such as Pötenitzer Wiek and Schlutuper Wiek.

The shipping channel is maintained by dredging at a minimum depth of 26 ft., and in places is only 164 ft. in width, notably near Schlutup. The river Trave is navigable by vessels of $24\frac{1}{2}$ ft. draught to Travemünde, and by vessels of 23 ft. draught to Lübeck. The channel is marked by dolphins, some of which are lighted. Immediately above Schlutup, the river is crossed by a double drawbridge, which when open has a passage 164 ft. wide; when closed, there is a clear height of 25 ft. above the water over the middle of a passage 33 ft. wide.

For the passage of the Trave channel pilotage is compulsory for merchant vessels, except for those not exceeding 200 cubic m. capacity; pilots are stationed at Travemünde and board vessels at the anchorage outside the river entrance. Between Schlutup and Lübeck, vessels of 4,000 cubic m. capacity or above, or of 20 ft. draught or above must be assisted by two tugs.

The entrance channel and the channel to Lübeck are kept open by ice-breakers so long as Lübecker Bucht is not closed by ice. The average number of days during which the Trave is closed each winter is fourteen, but this number is very variable; during a period of ten winters, the maximum number of days closed was fifty-seven, the minimum none.

Detailed Description

Travemünde. The harbour of Travemünde consists of the stretch

of river for a mile upstream from the north mole-head at the river entrance. Depths of 31 ft. extend over a width of about 300 ft. between the dolphins on either side. There are steamer wharves on the Travemünde (north) side, and coal discharging wharves on the Priwall (south) side of the river. Short jetties and landing stages project into the channel from the north bank and one jetty from the south bank; the total length of landing stage is 4,850 ft. Quayage includes the Ostpreussen Kai (developed between 1929 and 1937), with a length of 390 ft. and depth alongside of 28 ft.; a new berth for tourist vessels, depth alongside 25 ft., and a quay for passenger vessels, length 325 ft., and depth alongside 28 ft. There is a small pilot-boat harbour protected by jetties to the west of the north mole-head, and a fishing-boat harbour in the bend of the river immediately above the town.

Lübeck. The medieval town stands on an oval island in the Trave. The branches of the river on either side of the town, some 1,200 yds. apart at their farthest, together with the main river below the town as far as Teerhofs island, afford a considerable distance of natural water-frontage with a total length of some 20,000 yds. of quay. About a fifth of this quayage is used by canal traffic.

The maritime port consists of three main groups of basins. The lower basin (Umschlag-Hafen I), continued by the Burgtor-Hafen, extends upstream from a point to the south of Teerhofs island; it is about 1½ miles long, varies in width from about 100 to 300 yds., and has depths of 27 ft. The outer and inner basins lie parallel to one another on the west side of the old town, on either side of the Wall peninsula. The outer basin, consisting of the Wall-Hafen and the northern part of the Stadtgraben, is about a mile long, 140 to 240 ft. wide, and has depths of 25½–28 ft. It is crossed by a road and railway drawbridge halfway along its length, with a passage 40 ft. wide. The inner basin, consisting of the Hansa- and Holsten-Häfen is about 1,600 yds. long, about the same width as the outer basin, and has depths of 21–26 ft. It is also crossed by a road and railway drawbridge halfway along its length, with a passage 42 ft. wide. The small Petroleum-Hafen lies to the west of the southern end of Teerhofs island.

The Elbe-Lübeck (Trave) C. joins the river Trave some 1½ miles below the town. The arm of the river to the east of the old town has been made into a canal basin, known as the St Jürgen-Hafen to the south and as the Klug-Hafen to the north; these two are separated by the Hüxtertor bridge, while the Klug-Hafen is

separated from the Hansa-Hafen by a railway bridge and by the Bürgtor road bridge. The Klug-Hafen is 4,265 ft. long, with a 13 ft. depth of water, while the St Jürgen-Hafen is 13,000 ft. long, with depths of 10 ft. Transhipment from ocean to river craft takes place in the Umschlag Hafen I. The Stadtgraben, which extends from the railway bridge at the southern end of the Wall-Hafen to the Trave, is 6,200 ft. long, with 11 ft. of water. The Ober-Trave channel, which extends from the southern end of the Holsten-Hafen, is 3,300 ft. long and has 10 ft. of water. Both the last two basins are used by canal craft.

Extensive harbour improvements are in progress and intended, mainly in the neighbourhood of Teerhofs island. The Vorwerker Industrie-Hafen, which has recently been excavated along the left bank above Teerhofs island, was in course of construction during 1939. Plans include the provision of two large free basins on the right bank opposite the island and the deepening of the channel to Travemünde.

Minor Harbours along the Trave. There is a narrow harbour at Herrenwiek, on the left bank of the river about $5\frac{1}{2}$ miles above Travemünde. It is about 1,500 ft. long and 145 ft. broad with a depth of 24 ft. The harbour is owned by the neighbouring smelting works, and is used primarily by Swedish iron-ore ships. At Schlutup is the Schlutuper Industriehafen, 2,950 ft. long, 130 ft. wide at the bottom and 18 ft. deep, while above Schlutup the cutting (*Durchstich*) followed by the shipping channel is lined with 720 ft. of quays. There is an important fishing harbour in the Schlutuper Wiek with a further 720 ft. of quays.

Port Facilities

Travemünde. There are extensive warehouses on either side of the Trave. A small shipyard is situated on either side of the river above the town; its capacity appears to be limited to launches, yachts and other small craft. A dry dock, lying near and to the south of the shipyard on the left bank of the river, was reported to have been completed in December 1940.

Lübeck. There are extensive warehouses and quay sheds along the various basins. The most important area is the Wall peninsula, between the Wall-Hafen and Hansa-Hafen, which has been equipped for the large-scale handling of bulk cargoes, including a three-storey grain elevator with pneumatic conveyor equipment, of 10,000 tons capacity.

Repairs of all kinds were formerly undertaken at the Koch shipbuilding yard, now disused, on the right bank of the river in the lower basin. The chief yard is that of the *Lübecker Flenderwerke A.G.* at Siems, which has a steel floating dock 275 ft. long and 59·5 ft. wide at the entrance, with 18 ft. of water on the sill, and a lifting capacity of 3,000 tons. The yard has five slips, of which two are 520 ft. long, and a broadside slip. The yard normally builds small merchant vessels (largest 5,831 tons), dredgers and pontoons. Floating docks are also constructed in this yard; one of 8,000 tons capacity has been built. The *Lübecker Schiff- und Maschinenbau A.G.* has two slips of 490 ft. and a broadside launching slip. Up to 1930, the largest ship built was 2,480 tons.

There are several electric cranes lifting 1½ to 40 tons at Lübeck harbour. There are some small cranes with a lifting weight of 5–19 tons, a stationary crane with a lifting weight of 150 tons, and a crane on a pontoon with a lifting weight of 50 tons.

The Town

Lübeck was once the leading city of the powerful Hanseatic League and a Free City of the Holy Roman Empire. In the nineteenth century it was a Federal State, first of the *Bund* of 1815, and then of the united Reich of 1871. It maintained its status under the Weimar Republic of 1919, but the Nazis, with scant respect for ancient traditions of the city, found it convenient for purposes of administration to incorporate Lübeck in Prussia. Since 1937 Lübeck has been a town in the *Regierungsbezirk* Schleswig of the Prussian province of Schleswig-Holstein.

The outport of Travemünde was for a long time a separate town lying in the territory of the state of Lübeck. In 1913, however, it was incorporated in the municipal area of the city of Lübeck. Travemünde consists of two urban areas—Travemünde-Stadt (where a lighthouse is situated) and Travemünde-Strand (which is a seaside resort).

Lübeck developed at the entrance of a natural gateway from the lower Elbe region to the Baltic. It was in this depression that the Elbe-Trave C. was constructed. The first settlement lay at the point where the river Schwartau joins the river Trave. This settlement was destroyed in 1138. A second settlement was founded in 1143 a little farther up the Trave where that river is joined by the Wakenitz. The new site was a spit of land some 15 m. higher than the surrounding marshes through which flowed the Trave and the

Wakenitz. A firm foundation for building, a good water supply and the protection afforded by the marshes made the site an attractive one. Later, a castle was built on the northern edge of the oval-shaped high land and on the southern edge there developed a small trading settlement. In the second half of the twelfth century the district immediately to the north of the first trading settlement grew up around two churches—the *Petrikirche* and the *Marienkirche*. In the next century the gap between the southern settlements and the castle to the north was built upon. At the same time the area of firm high land was artificially extended.

Many fine buildings have survived from the days of the great period of prosperity in the middle ages. Some of the more important are the gateways *Holsten Tor* and *Burg Tor*; the Town Hall (thirteenth–fifteenth centuries); the magnificent *Marienkirche* (1251–1310); the house of the *Schiffer Gesellschaft* (built in 1535 and restored in 1880) and the sixteenth-century *Heiligen Geist Hospital* (rebuilt in 1840). The museums of Lübeck include the *Museum am Dom* (natural history) and the *Museum für Kunst und Kulturgeschichte* (local history and local crafts).

Lübeck declined in the sixteenth, seventeenth and eighteenth centuries and there was little urban expansion in that period. In the nineteenth century, following some improvement in trade, suburbs began to develop on the hills on either side of the Trave. St Lorenz grew up in the west, St Jürgen in the south and St Gertond in the east. There was some further expansion along two main roads out of the town—the *Schwartauer Allee* to the north and the *Israelsdorfer Allee* to the north-east. When the Elbe-Trave C. was built (1900) new basins were constructed to the north and west of the town.

Until it was absorbed by Prussia Lübeck was the headquarters of the administration, both of the municipal area (to which Travemünde was added in 1913) and of adjacent districts which were part of the Federal State of Lübeck. Offices of the Reich in Lübeck include those for customs, finance and public works.

The medieval centre of Lübeck has been severely damaged by fire as the result of air attack, and much rebuilding will be necessary. The port facilities have been largely reconstructed.

History

Count Adolph II of Holstein founded Lübeck in 1143. The town soon came under the control of Henry the Lion of Saxony. It was in

Plate 25. Kiel: Innenhafen, looking east from the Rathaus tower
The *Deutsche Werke*, Süd Werft, is in the background.

Plate 26. Kiel: Innenhafen and Die Hörn, looking south
On the left is *Krupps Germania Werft*. The railway station is in the right background.

Plate 27. Flensburg

Plate 28. Lübeck

Danish hands between 1201 and 1225, but in 1226 Lübeck became a Free City of the Empire. In 1227 Lübeck and Holstein together defeated the Danes at Bornhöved and turned them out of the district around Lübeck. The town came to acquire some small scattered territories outside its urban area—e.g. the useful outport of Travemünde, together with Schlutup, Ritzerau and Behlendorf. The district of Bergedorf was (after 1420) held jointly by Lübeck and Hamburg.

Lübeck was not free from the rivalry between the wealthy merchants and the craftsmen which was to be found in many German towns in the middle ages. In 1384, for example, a conspiracy was unearthed which aimed at the murder of the whole Town Council and the richest citizens. The thirteenth and fourteenth centuries were a period of great economic prosperity and political influence for Lübeck. The exports of the port were valued at £140,000 (modern currency) in 1384. Between 1390 and 1398 the merchants of Lübeck constructed the Stecknitz C. as a link between the Elbe and the Baltic, thereby improving access to the hinterland of the port.

Lübeck was the leading city in the Hanseatic League which included the main commercial towns of northern Germany. Starting from a defensive alliance against pirates between Lübeck and Hamburg (1241) and between Lübeck, Rostock and Wismar (1259), there developed a great association of German trading cities to foster their commercial interests. Towns as far apart as Reval, Amsterdam, Köln, Breslau and Cracow were members of the League. Trading factories (*Kontors*) were set up in London, Bruges, Bergen and Novgorod. The Council of the Hanseatic League met regularly at Lübeck. The commercial law of the city (*lübisches Recht*) came to be widely used in German towns. In the fourteenth century, the League was strong enough to wage war successfully upon Denmark (whose seizure of Wisby carried with it a threat to dominate the Baltic). A great victory of the League over Waldemar Atterdag was followed by the Peace of Stralsund (1370) which made the League the master of the Baltic for 150 years, and was the high-water mark of its political fortunes.

The Hanseatic League declined in the fifteenth and sixteenth centuries. Political causes included serious disputes between the members (Köln, for example, challenged Lübeck's paramount position); powerful territorial states arose in Germany (Brandenburg, for example, forced its towns to withdraw from the League between 1448 and 1488); and there was a revival in the power of the hostile

Scandinavian States. Economic causes of the decline of the League included the departure of the herrings from the Baltic after 1425 and the shifting of the world trade routes during the great age of geographical discovery. The future lay with the great ports of the North Sea. Lübeck's trade declined, and even as far as Baltic commerce was concerned she was at a disadvantage when ships too large for her shallow waters came into use: trade was attracted to Stettin and Danzig.

After unsuccessful wars against Denmark (1531–5) and Sweden (1563–70) Lübeck's political power declined. In the seventeenth and eighteenth centuries she still had a considerable commerce and some industries—such as shipbuilding—but she was no longer one of the great ports of the Continent. During the Napoleonic Wars Lübeck—defended by Blücher—was stormed by the French (6 November 1806), who plundered the city and eventually incorporated it in their empire (1810–13). Lübeck regained her independence after the Napoleonic Wars and became a Federal State of the *Bund* (1815). The old aristocratic constitution of 1669 was restored. Like Hamburg and Bremen, she was still a 'Hansa City'. The three Hansa Towns maintained close relations with each other. Lübeck, though now of far less economic importance than the two great North Sea ports, nominally retained her status of the leading Hansa town. It was, for example, in Lübeck that the Hansa Towns had their joint Court (*Oberappelationsgericht*) 'which worked rather slowly but very industriously'. The maintenance of joint consulates abroad and the joint negotiation of commercial treaties with foreign Powers were other examples of co-operation between Lübeck, Hamburg and Bremen in the days of the *Bund*.

In the first half of the nineteenth century the trade of the port increased somewhat as communications in Germany were improved and a measure of economic unity was attained. Lübeck, however, followed the example of Hamburg and Bremen and remained for many years outside the Zollverein. The port still had to face many difficulties. On the one hand, Prussia fostered the rival port of Stettin at Lübeck's expense. On the other hand, Denmark took advantage of her geographical position to hamper the trade of the port. For years she prevented the construction of a good modern road from Lübeck to Hamburg through Holstein. She levied high tolls on the Sound until 1857 and so taxed Lübeck shipping passing between the Baltic and the North Sea. For a time she prevented the building of a railway from Lübeck to Hamburg as she wanted no

competition with her own line from Kiel to Altona. Moreover, big modern ships could not reach Lübeck owing both to the unsatisfactory state of the river between the port and Travemünde, and to the fact that the harbour at Lübeck was a shallow one and dock facilities were inadequate. Marine insurance rates were higher for ships using the Baltic than the North Sea.

Conditions improved somewhat after 1868 when Lübeck joined the Zollverein on favourable terms. The completion of the Elbe-Trave C. (1900), the regularization of the lower Trave and the provision of new basins attracted trade. Imports of timber and ores from Scandinavia and Russia, and exports of fertilizers, colonial goods and manufactured articles became considerable items in the commerce of the port. New industries developed in the early years of the twentieth century on the left bank of the Trave. They included iron works, oil mills, the manufacture of machinery (e.g. the *Lübecker-Werke G.m.b.H.* and the *Berlin-Lübecker Maschinenfabrik Bernhard Berghaus*) and aircraft. There is also a fish-curing industry.

Since 1885 Lübeck's population has increased as follows:

1885	55,000	1925	121,100
1900	82,098	1932	130,000
1907	94,000	1938	145,900

Trade

The following figures summarize the trade of Lübeck and Travemünde for 1936 and 1937, the latest years for which statistics are available:

	Coastwise		Foreign		Total
	Outwards	Inwards	Exports	Imports	
1936	118·3	484·5	467·2	1,090·9	2,160·9
1937	108·0	470·1	524·9	892·4	1,995·4

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

It will be seen that the tonnage of imports, both coastwise and foreign, considerably exceeds that of exports. While exports comprise a variety of miscellaneous items, imports are dominated by coal, iron ore and timber.

Imports. The following table summarizes the imports of Lübeck in 1937:

	Tons		Tons
Coal	493,066	Timber for pulping	79,098
Iron ore	295,904	Maize	12,113
Sawn timber	170,803	Cement	11,560
Stone	86,417	Sleeper (wood)	10,941

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, pp. 38–47.

The countries from which Lübeck obtained most of its foreign imports in 1937 were as follows:

	Tons		Tons
Sweden	280,918	Gt. Britain	38,909
Netherlands	222,192	Greece	32,995
Finland	134,649	Latvia	30,728
Norway	56,537		

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, pp. 38–47.

The imports of coal came mainly coastwise from the Ems (360,000 tons), together with nearly 120,000 tons from the Netherlands. Iron ore came mainly from Sweden (209,000 tons) with small quantities from Norway and Canada. The timber and associated products were from Finland, Latvia and Sweden.

Exports. The following table summarizes the main exports of Lübeck in 1937:

	Tons		Tons
Salt	118,640	Lignite briquettes	19,732
Coke	102,032	Slag	16,334
Pig-iron	69,888	Maize	15,131
Potash fertilizers	47,077	Nitrogenous fertilizers	11,812
Iron and steel tubes	20,124	Cement, mortar	10,544

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, pp. 38–47.

The countries to which Lübeck sent most of its exports were Sweden (254,642 tons), Denmark (185,713 tons) and Finland (53,321 tons). It is interesting to note that salt, derived from the extensive deposits of the Lüneberg Heath, has since medieval times been Lübeck's premier export; it went in 1937 mainly to Sweden (64,000 tons) and to Denmark (28,000 tons). Coke likewise went to these two countries (43,852 and 44,646 tons respectively), and they were also the main customers for most of the other exports, notably of pig-iron from the Herrenwiek works (see below), fertilizers and feeding stuffs.

Industries

Travemünde. The main industrial enterprises in Travemünde are those connected with the airfield and seaplane base at Priwall; the buildings are largely those of the former *Caspar* aircraft works. There is also a small shipyard (see p. 126).

Lübeck. There is a blast-furnace plant, with an annual capacity of 400,000 tons of pig-iron, at Herrenwiek, $5\frac{1}{2}$ miles above Travemünde, with its own harbour (see p. 126). Engineering concerns include the *Lübecker Maschinenbau*, which makes marine boilers, a branch factory of *Dornier Metallbauten* (*Leichtmetall, Lübeck*), which

makes fuselages for the Wismar factory, and the *Stadtwerft* (*Lübecker Maschinen-und Eisenwerke*), which manufactures armaments. Lübeck is important mainly as a shipbuilding port, constructing the smaller types of warships, floating docks, locks, pontoons, small merchant vessels, dredgers and floating cranes, tugs and barges. The two shipbuilding concerns are the *Lübecker Flenderwerke* and the *Lübecker Maschinenbau-Ges.* The former has also a big structural steel and bridging department. There is also a factory concerned with the manufacture of various lead products.

There are a number of chemical and allied works, including the *Lübeckerwerke* chemical plant on the right bank of Umschlag-Hafen I near the former Koch shipyard, a large sulphuric acid and super-phosphate factory with river frontage at Dänischburg, a cobalt refinery, a tyre-retreading plant, and an enamel factory. A large oil and tar refinery is situated on Teerhofs island on the banks of the Petroleum-Hafen.

There is a large brick-works west of the Vorwerker Industrie-Hafen, and a considerable fish-drying factory.

Communications

Railways. The main railway station in Lübeck, with the neighbouring goods yard, is at St Lorenz, to the west of the Stadtgraben. From it lines run northward along the western quays of the Wall Hafen, the Umschlag-Hafen, the Vorwerker industrial harbour and Teerhofs island; branches serve the quays on either side of the Wall peninsula, while a line crosses the drawbridge between the Hansa-Hafen and Holsten-Hafen to the main island, and continues across the Klug-Hafen to the quays along the east side of the Umschlag-Hafen. Lines also run along either side of the Klug-Hafen as far as the Hüxtertor bridge.

From the Lübeck main station, double-track lines run south-westward to Hamburg and eastwards to Rostock. A single-track line goes southwards to Hagenow, a junction on the main Hamburg-Berlin line, thus forming the most direct route between Lübeck and Berlin. Other single-track lines run north-eastwards to Travemünde, northwards to Neustadt and Heiligenhafen (thence to Fehmarn island), and north-westwards to Eutin and Kiel.

The Town Station at Travemünde lies near the northern outskirts of the old town on the left bank of the Trave, while the Strand Station serves the holiday resort of Neu-Travemünde. A branch line with sidings serves the shipyard and the quays of the fishing

harbour, but none of the other parts of the harbour has rail connexion. The single-track line from Lübeck enters the Town Station from the south, and continues northwards to its terminus at Niendorf.

Waterways. Above Lübeck, the river Trave is a meandering river unnavigable save for boats. The Elbe-Trave C., 43 miles in length, connects the St Jürgen-Hafen to the south of the town with Lauenburg on the Elbe. The canal, which is 43 miles in length, with a least width of 39 ft. and a least depth of 8 ft. thus provides a link between Hamburg and the Baltic (see p. 604).

Roads. See Fig. 17.

WISMAR (Plate 29)

53° 54′ N., 11° 28′ E. Population: 27,493

The port of Wismar lies at the head of Wismar Bucht, on the southern side of Mecklenburger Bucht.

Approach and Access

Wismar is approached by a dredged channel across Wismar Bucht, a large square-cut bay almost completely filled with sand-banks and rocky shoals. The mouth of Wismar Bucht is impeded by an extensive shoal, known as Hannibal, with a least depth of $1\frac{1}{4}$ fm. The Bucht can be entered either through Grosse Tief, a channel between Hannibal and Poel island on the east, with depths of 23 ft., or through Offen Tief, a channel between Hannibal and the Lieps bank on the west, with depths of 16 ft. The distance to Wismar by the former route, which is the main entry, is $13\frac{1}{2}$ miles, by the latter 10 miles. Both entrance channels lead to Kraken Tief, an area of deep water south of Hannibal, and thence the main channel, with a least depth of 21 ft., leads through the outer and inner roads, and continues with a depth of $19\frac{1}{2}$ ft. into Wismar harbour. Anchorages are available in the outer road, in depths of $4\frac{1}{4}$–$4\frac{3}{4}$ fm. and in the inner road, in depths of $3\frac{1}{4}$–$3\frac{3}{4}$ fm.

The entrance channel to Wismar is kept open as long as possible by ice-breakers. The average number of days during which the port is closed by ice each winter (based on a ten-year period of observation) is thirteen, but this number is extremely variable. In a very hard winter it may be closed for as many as forty-six days; in other years it may remain completely ice-free.

Detailed Description

The port of Wismar consists of four basins which have been excavated at the head of the bay. These, from north-east to south-

west, are the Industrie-Hafen, the Kohlen-Hafen, the Alter-Hafen and the West- (or Holz-) Hafen. The Industrie-Hafen is 1,558 ft. long, 330 ft. wide and 15 ft. deep. The Kohlen-Hafen, which lies near the main goods station, and widens out at its head to form a small inner basin, has depths of 20 ft. The Alter-Hafen (formerly the sole basin in the port of Wismar), is 1,640 ft. long and up to 20 ft. deep; it narrows towards its head, and has an average width of 130–60 ft. The West-Hafen, which is about 1,500 ft. long and 330 ft. wide, has depths up to 20 ft.; it is quayed on the east and south, and has a loading ramp. The total length of quays along these four basins is 14,600 ft.

Port Facilities

All four basins have adequate storage accommodation, especially the Alter- and Kohlen-Hafen. The former has two large grain silos with modern loading equipment, of 4,500 and 9,000 tons capacity respectively; there are also two grain storehouses with a total capacity of 5,500 tons, and a number of large sheds for sugar and grain with a total floor space of about 6,600 sq. yds. The Kohlen-Hafen has some 14,000 sq. yds. of storage space for coal and stone, and three large modern coal unloading plants.

A small shipyard, the *Stadt Wismar Hafenbauamt*, is situated to the west of the harbour basins; it has a patent slip to take vessels 98 ft. long and to lift 200 tons. The firm of *J. Schroder und W. Schackow* has a boatbuilding yard, with a patent slip to take vessels 65 ft. long. The *P. H. Podeus* engineering works is able to execute minor repairs and to make castings up to 3 tons.

Lifting appliances comprise an electric travelling crane of 15 tons capacity, two 7-ton bridge cranes, and an electric bridge crane of 112 ft. reach and 5 tons capacity.

Trade

The following figures summarize the trade of Wismar for 1936 and 1937, the latest years for which statistics are available (in thousands of tons)

	Coastwise		Foreign		Total
	Outwards	Inwards	Exports	Imports	
1936	41·4	23·1	39·3	110·9	214·7
1937	48·8	23·4	21·8	127·1	221·1

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

No detailed figures of the trade of Wismar are available, as its returns are included in those of the 'Ports in Mecklenburg' traffic district. Its total trade was about half that of Rostock, by far the most important port in the region. It will be seen that foreign imports comprised more than half of the total.

The chief imports were coal, all of which came from Great Britain, stone (chiefly granite and chalk), phosphatic and other fertilizers, sawn timber, and live pigs. Exports, chiefly to Denmark and to the Netherlands, comprised rye, wheat, oats and barley (both grain and flour), refined sugar and paper.

Industries

There are two small shipyards at Wismar, the *Stadt Wismar Hafenbauamt*, and the *J. Schroder und W. Schackow* concern. The *P. H. Podeus* engineering works is situated to the south of the town (see p. 135). The important *Dornier* aircraft factory (*Dornier Metallbauten G.m.b.H.*) is situated on the eastern shores of the inner part of Wismar Bucht; it is supplied by two subsidiary component factories in Wismar. Minor enterprises include a stove factory, a sugar refinery, a malt mill, a large abattoir, a paper factory, and a wagon works and repair shop.

Communications

Railway. The railway station lies east of the town of Wismar with the goods station and yards near the southern end of the Kohlen-Hafen. All four of the harbour basins have rail connexions, while a line runs north to the Dornier factory, and sidings serve the wagon works and sugar factory. A single-track line runs southwards to Bad-Kleinen, a junction on the Lübeck-Rostock main line, and beyond to Schwerin, while another runs north-eastwards to Rostock.

Inland waterways. None.

Roads. See Fig. 17.

ROSTOCK WITH WARNEMÜNDE (Figs. 33, 34; Plates 30, 31)

Rostock 54° 06′ N., 12° 08′ E. Population: 93,530 (1933); 113,000 (1938)

Warnemünde 54° 11′ N., 12° 06′ E. Population: 28,000 (1933)

Rostock, the largest commercial port in Mecklenburg, lies about seven miles above Warnemünde, its outport, at the mouth of the river

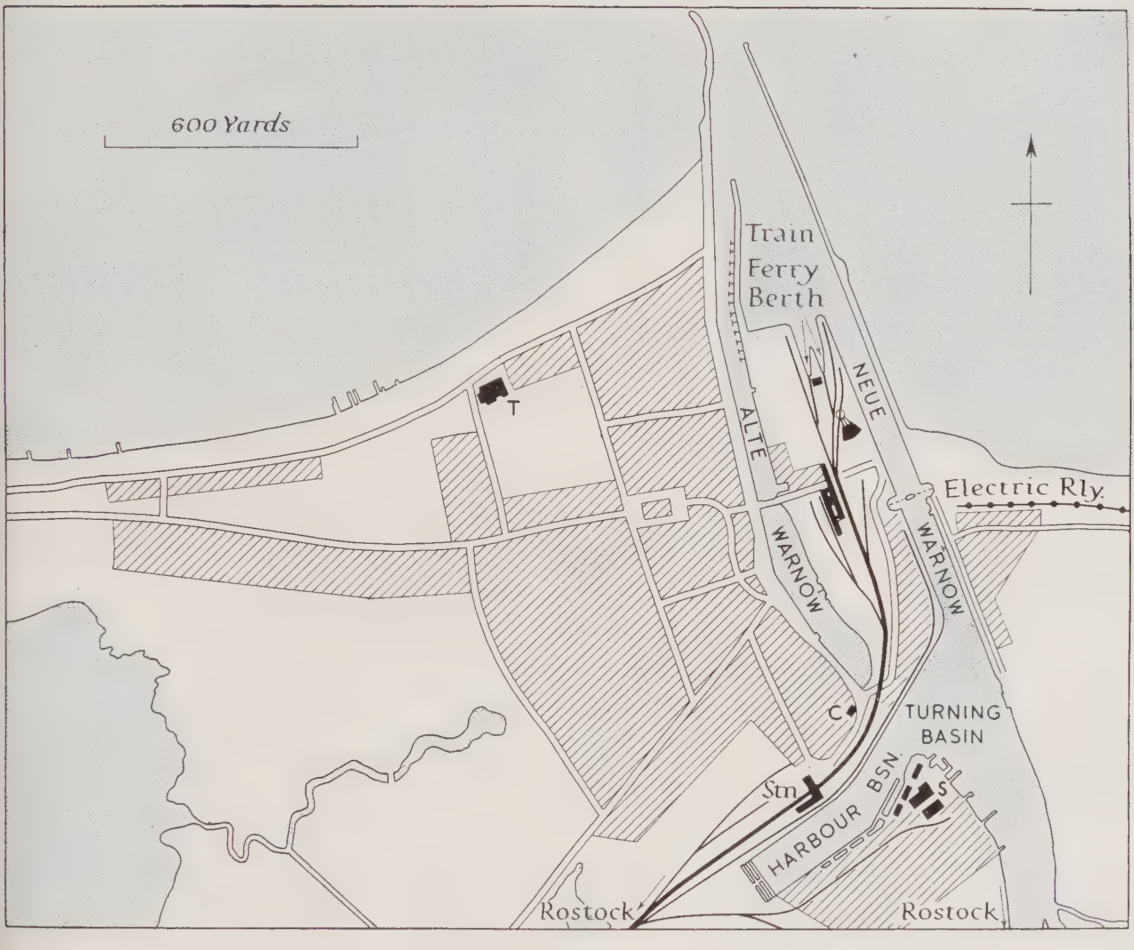

Fig. 33. Warnemünde
Based on official sources.
C Customs; S *Kröger* shipyard; T Town Hall.

Fig. 34. Rostock

Based on official sources.

C Customs; C.Stn. Central station; fd Floating dock; F.F.Stn. Friedrich Franz station; G Gasworks; H *Heinkel* works; P Power station; P.S.Stn. Park Strasse station; NS *Neptun* shipyard; R.W. Railway

Warnow. Rostock is an important port for trade with Scandinavia, while the main function of Warnemünde is that of a ferry port for rail traffic between Berlin and Copenhagen; a train-ferry connects the outport with Gedser, on the Danish island of Falster.

Approach and Access

The river Warnow, known as the Unter-Warnow between Warnemünde and Rostock and as the Ober-Warnow above the latter, is entered from the open sea between the breakwaters forming the outer part of Warnemünde Hafen. The width of this entrance is 328 ft. with depths on the river bar and at the harbour entrance of 20–23 ft. Heavy gales between west and north-west sometimes reduce the depth, but shoal spots are removed by dredging. Anchorage is available in Warnemünde road, off the mouth of the river, in depths of about 5 fm.

Above Warnemünde Hafen, the river widens out into an extensive shallow lagoon, the Breitling, about 1–1½ miles wide. The buoyed shipping channel to Rostock, navigable by vessels of 18 ft. draught, passes along the western side of the Breitling, and then up the Unter-Warnow, following its right bank. The river bed, in places more than half a mile wide, is shallow and sandy.

Pilotage is compulsory for merchant vessels; pilots board vessels at the anchorage outside the river entrance. Passenger steamers plying between Warnemünde and Rostock undertake the towage of vessels.

The river mouth at Warnemünde rarely freezes, and even then only for a short period, as the ice is broken up by rising water and carried away by the current. The Gedser mail steamers are prevented from running only during very severe winters. Between Warnemünde and Rostock the river freezes more readily than in the entrance, but as long as the entrance is not closed by ice the channel is kept open by an ice-breaker. The average number of days per winter during which the river is likely to be closed by ice is ten (over a ten-year period of observation during which the maximum was forty-nine and the minimum nil).

Detailed Description

Warnemünde. The harbour is entered between the west and east moles, which project from the coast on either side of the river mouth; they are 1,640 ft. and 3,280 ft. long respectively. Within this outer harbour, which has depths of 16–23 ft., a central mole, 1,100 ft. in

length, projects northwards from the western corner of a peninsula between the main river channel (the Neue-Warnow), and a former channel (the Alte-Warnow), now a cul-de-sac. At the head of this peninsula are the train-ferry berths. The Neue-Warnow, entered eastward of the ferry berths, has 2,624 ft. of quays, with depths of 23 ft. in the channel and of 18 ft. alongside the quays. The Alte-Warnow, entered between the central mole and the western breakwater, has depths of 16 ft. in the middle and of 5–10 ft. at the wharves. The basin is crossed about halfway along by a swing bridge with two openings, each 33 ft. wide. Immediately south of the Neue-Warnow is the turning basin, which has 1,443 ft. of quays and depths alongside of 13–16 ft.; vessels of 23 ft. draught can turn with a radius of 328 ft. The harbour basin, about 1,200 ft. long and 300 ft. wide, is situated to the south-west of the turning basin, and has depths of 13–16 ft. The quarantine and winter harbour lies in the old mouth of the Warnow, to the south of the turning basin.

Rostock. Just below the town of Rostock the Warnow makes an easterly bend; the southern bank, fronting the town, is lined with 6,735 ft. of quays, with depths alongside ranging from 12 to 19 ft. Numerous short jetties project into the river. The coaling quay, about 1,200 ft. long and 200 ft. wide, projects westwards, parallel to the main waterfront; behind it is the Haedge-Hafen. Small piers on the northern bank of the river form yacht basins.

At the eastern extremity of the reach of river forming Rostock Hafen, the Warnow bends southwards. A lock, 169 ft. long and $21\frac{1}{2}$ ft. wide, with depths of 9 ft., connects the Unter- and the Ober-Warnow; the latter is navigable only by tugs and barges as far upstream as Butzow, a distance of 24 miles.

Port Facilities

Warnemünde. The port is primarily used for passenger traffic, and warehouse accommodation is limited. There are large coal and oil fuel stores, and buildings to serve the train ferry berths.

A shipyard, owned by *Gebr. Kröger*, is situated in the south-western corner of the turning basin; this yard has a small slipway. Lifting appliances comprise two 15-ton steam cranes, one in the harbour basin, the other in the turning basin.

Rostock. The port has extensive storage buildings, including a grain silo of 6,000 tons capacity, and some 90,000 sq. yds. of open storage space.

The most important shipbuilding and repairing yard is the *Neptunwerft Rostock Schiffswerft und Maschinenfabrik G.m.b.H.*, situated on the left bank of the Warnow below the port. It has a steel floating dock, 400 ft. long, 57 ft. wide at the entrance, and with a lifting capacity of 4,000 tons; it is composed of three pontoons.* There is also a patent slip 250 ft. long, with a lifting power of 700 tons, and five other slips of 350–600 ft. in length. Merchant ships up to 4,500 tons have been constructed in this yard. A smaller yard is that of *O. Ludewig und J. Moller*, near the eastern end of the harbour. It has two small slips 82 ft. and 49 ft. long, with lifting capacities of 200 and 50 tons respectively.

Lifting appliances comprise an 80-ton sheers and 40-ton floating sheers, both belonging to the *Neptun* yard; a 25-ton electric turning crane on the coaling quay; a 3-ton electric travelling crane; a modern electric handling bridge with slewing crane of 5-tons lifting capacity, with a grab for bulk goods; and a number of electric grabs.

The Town

Rostock, the chief port and principal city of Mecklenburg, lies on the left bank of the river Warnow roughly 7 miles above the point where it flows into the Baltic by way of the Breitling salt lagoon. A sluice at Rostock divides the upper Warnow from the lower Warnow. The upper Warnow is crossed at Rostock by a railway bridge, by the *Mühlendamm* and by the *Petri Brücke* which links Rostock and Karlshof. A ferry joins Rostock with Gehlsdorf which lies on the other side of the lower Warnow. It was as a crossing-point of the river that the town early became important. The height of the banks on a sharp bend of the river Warnow facilitated the crossing of the river and this was the lowest point at which the Warnow could be conveniently bridged. In the middle ages there were three independent settlements at Rostock each with its own church and market place. Later these little townships—the *Altstadt*, the *Neustadt* and the *Mittelstadt*—were united within a single system of fortifications which, to a great extent, still survives.

The modern expansion of the town has been mainly to the north and west (where residential districts have arisen), also along the Warnow river—below the old town at Marienehe—where important industries such as shipbuilding have developed. Notable medieval buildings which have survived from the days of Rostock's prosperity

* A second dock, 310 ft. × 80 ft., was observed early in 1945.

as a member of the Hanseatic League include the fourteenth-century Town Hall, the *Marien Kirche* (thirteenth–fifteenth centuries), the *Nikolai Kirche* (restored in 1893), and two towers—the *Kropeliner Tor Turm* and the *Langebusch Turm.* Modern monuments include a statue to Blücher, who was a native of the town.

Rostock is a centre of learning and culture. It is the seat of Mecklenburg's ancient university—founded in 1418 by Dukes Johann III and Albrecht V—and also of the modern *Mecklenburg-Schwerinisches pädagogisches Institut* (1926). There are also a Geological and Mineralogical Institute, a Museum of Art and Antiquities, and a Municipal Theatre.

The town has administrative functions in the Reich and in Mecklenburg. Offices of the Reich include those for finance and customs. Rostock is the seat of the Court of Appeal (*Oberlandesgericht*) for Mecklenburg.

The small outport of Warnemünde—which is administered as part of the municipality of Rostock—has grown both because it has become the terminus of the train ferry to Gedser in Denmark (on the main Berlin-Copenhagen route) and because it has developed as a popular seaside resort. Warnemünde's industries include aircraft production (see p. 143). The population in 1933 was 28,000.

History

Mecklenburg was occupied in the seventh century by the Wends (Obotrites) who were overthrown—in the twelfth century—by Henry the Lion of Saxony. (Descendants of a Wendish prince became the ruling house in Mecklenburg in 1348.) The first Wendish castle and settlement of Rostock on the right bank of the river Warne was destroyed by the Danes in 1160. Ten years later the Obotrite prince Pribislav built a new castle. Meanwhile the first German settlement on the left bank of the river (the *Altstadt*) had come under the control of Henry the Lion. In 1265 the *Altstadt* was joined by the two adjacent settlements of *Neustadt* and *Mittelstadt* to form a single township. Between 1301 and 1323 the town was occupied by the Danes.

Rostock was the principal town and seaport of Mecklenburg and was the seat of a university. It enjoyed a period of prosperity as a member of the Hanseatic League, and had an important trade in herrings. The population of the town in 1384 has been estimated at 10,000.

The port declined in the seventeenth century. Wallenstein occupied Mecklenburg in 1629–31. Rostock was long spared the fate of its neighbours Wismar and Stralsund which, for a time, were incorporated in the Swedish dominions. But in the Northern War it fell in turn to Sweden (1712), Denmark (1715) and Russia (1716). Subsequently it was returned to Mecklenburg-Schwerin. (In 1701 Mecklenburg had been divided into Mecklenburg-Schwerin and Mecklenburg-Strelitz and the two territories were not united again until 1937.) The long disputes between Rostock and the rulers of Mecklenburg were at last settled in 1788 when Friedrich Franz I agreed to give Rostock many constitutional privileges. Some of these privileges were modified in 1880.

In the nineteenth century Rostock suffered with neighbouring ports from the continued decline of Baltic trade. In the middle of the century the main exports of Rostock were grain (mainly wheat and barley); peas; rape seed and oil cake; and wool. The average annual value of Rostock's exports in the forties was estimated to be £300,000. Imports consisted of manufactured articles from Britain (which came both by the direct route and also by way of Hamburg); hemp, flax and tallow from Russia; timber from Sweden; herrings and fish oil from Norway; and wines and brandy from France. The value of the annual imports by sea in the forties was about £250,000. Shipping, commerce and industry developed when the port was linked by rail with the main Berlin-Hamburg line in the fifties, and when the Mecklenburgs joined the Zollverein (1868) and then the united Reich (1871). Shipping improved and in 1913 the tonnage of incoming ships amounted to 1,553,000 and of outgoing ships to 1,567,000 tons.

Industries expanded and helped in revival. The most important were shipbuilding (e.g. the *Neptun* yard); timber and woodworking; the electro-technical industry; sugar refining; machine building and the construction of vehicles and aircraft (e.g. the *Ernst Heinkel Flugzeugwerke*). The Heinkel aircraft factory at Marienehe was the parent works, assembly plant and research centre of this important firm. There are also Heinkel works at Warnemünde (formerly *Arado Flugzeugwerke*).

The following table shows that—despite the economic dislocation of eastern Germany owing to the territorial arrangements of the Treaty of Versailles—there was an increase in the tonnage of vessels handled by Rostock and Warnemünde between 1913 and 1927.

Shipping Tonnage handled by Rostock and Warnemünde, 1909–1927 (*in tons*)

	Incoming ships		Outgoing ships	
	Laden	Empty	Laden	Empty
1909	1,163,174	21,233	1,098,240	92,930
1913	1,500,000	53,000	1,480,000	87,000
1926	1,595,000	70,000	1,641,000	24,000
1927	1,791,000	29,000	1,763,000	48,000

From: I. F. D. Morrow, *The Peace Settlement in the German Polish Borderlands*, p. 379 (Oxford, 1936).

The population of Rostock has increased as follows:

1838	18,067	1925	70,206
1885	39,000	1938	111,200
1905	60,790		

Trade

The following figures summarize the trade of Rostock and Warnemünde for 1936 and 1937, the latest years for which statistics are available:

	Coastwise		Foreign		Total
	Outwards	Inwards	Exports	Imports	
1936	55·9	61·3	143·6	160·9	421·7
1937	42·0	64·2	173·5	171·4	451·1

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

No detailed figures are available of the trade of Rostock and Warnemünde, as its returns are included in those of the 'Ports in Mecklenburg' traffic district, of which it is the most important. Its exports, in fact, amounted in 1937 to 216,000 tons out of a total for the whole Mecklenburg coast of 295,000 tons, although its imports were less dominant (236,000 tons out of a total of 414,000 tons), chiefly because several of the smaller ports, though they have few important exports, imported bulky supplies to serve their own hinterlands. Imports consisted mainly of coal, all of which came from Great Britain, sawn timber from Finland, maize, stone, and crude steel. Exports, chiefly to Denmark and the Netherlands, comprised rye, wheat and oats (both grain and flour), refined sugar, and miscellaneous chemical products.

Industries

Warnemünde. There is a small shipyard owned by *Gebr. Kröger* which can execute repairs and build small vessels. The *Arado Flugzeugwerke G.m.b.H.*, to the south of the town, formerly reported to be a subsidiary of the *Neptunwerft Rostock Schiffswerft und Maschinenfabrik G.m.b.H.*, and now a *Heinkel* branch, produces both fighter aircraft and seaplanes.

Rostock. The *Neptun A.G. Schiffswerft und Maschinenfabrik G.m.b.H.* is an important yard, building small naval craft, ice-breakers, and merchant ships up to 4,500 tons (see p. 139). In 1938 this yard launched seven ships of 19,700 tons. A small yard is that of *O. Ludewig und J. Moller.* The most important industrial concern is the *Heinkel* aircraft works (*Ernst Heinkel Flugzeugwerke G.m.b.H.*), with assembly works at Marienehe, 1½ miles north-west of Rostock. Within the town are three subsidiary *Heinkel* factories, for metal components, for woodwork and wings, and for light construction and fitting. A branch factory at the *Neptun* yard makes wings for the Warnemünde factory.

There are a number of industrial concerns connected with food products; these include a large margarine factory west of the town, a paste factory and a large sugar refinery. There is a chemical works on the left bank of the Warnow below Rostock.

Communications

Railways. There are three stations in Rostock, the Central station (*Hauptbahnhof*) to the south of the city, the Fredriks Franz goods station to the east, and Park Strasse station to the west. There are extensive sidings and sheds at the first two stations. Lines, with spurs and sidings, run along almost the whole length of the main waterfront, known collectively as the *Strand-Bahn*; this system has a double connexion with the main-line system, first by a line which runs through cuttings in the centre of the city to a junction near the main station, and second by a line along the Grubenstrasse to the goods stations. The *Neptun* yards are served by a line (with sidings) which branches from the main line to Warnemünde.

From Rostock a double-track line runs south-westwards to Lübeck, with junctions at Schwaan for Güstrow and at Bad-Kleinen for Wismar and Schwerin. A single-track line runs eastwards to Ribnitz and Stralsund, thence across the Rügendamm to Sassnitz, while another runs north near the left bank of the Unter-Warnow river

to Warnemünde. Here are single-track lines westward from Rostock to Wismar, via Bad-Doberan and Kröpelin, eastward to Sanitz and Greifswald, and south-eastward to Plaaz and Lalendorf.

At Warnemünde, the town station is situated on the north side of the harbour basin, to the south of the town. The main line continues north along the peninsula between the Neue- and Alte-Warnow rivers to the train-ferry berths at its northern end; the maritime station is situated south of the berths. In normal times, through traffic between Berlin and Copenhagen goes via Warnemünde; trains from Berlin and from Hamburg are taken on board the ferry, and are conveyed to Gedser on Falster island. Both quays of the harbour basin, and the western quays of both the turning basin and the southern part of the Unter-Warnow Channel, have railway connexions.

Inland Waterways. The Unter- is separated from the Ober-Warnow by the Mühlen Damm, in which there is a lock 169 ft. long and $21\frac{1}{2}$ ft. wide, with a depth of 9 ft. The Ober-Warnow has a least depth of 11 ft. as far as Butzow, 19 miles above Rostock, and is used only by small river craft.

Roads. See Fig. 17.

Stralsund (Figs. 35, 36; Plate 33)

54° 18′ N., 13° 05′ E. Population: 43,630 (1933)

Stralsund stands on the shores of the Stralsund Channel (or Strela Sund), the narrow stretch of water between the Pomeranian mainland and the island of Rügen. It is a small port, a naval training centre and an important railway junction; from it, the railway crosses the Rügendamm and traverses Rügen to Sassnitz, the important ferry port for Trälleborg in Sweden.

Approach and Access

Stralsund may be approached along the channel between Rügen and the mainland, either from the north-west or from the south-east. The former enters through the Gellenstrom, which lies between Bock Sand off Barhöft on the Pomeranian coast and The Gellen, the southern part of Hiddensee island. South of this entrance, the channel, known as the Vierendehlrinne, passes through the extensive sand-banks of the Kubitzer Bodden and into Stralsund Channel. This shipping channel, from Barhöft to Stralsund, has been dredged

Plate 29. Wismar

Plate 30. Warnemünde: train ferry steamer *Schwerin*

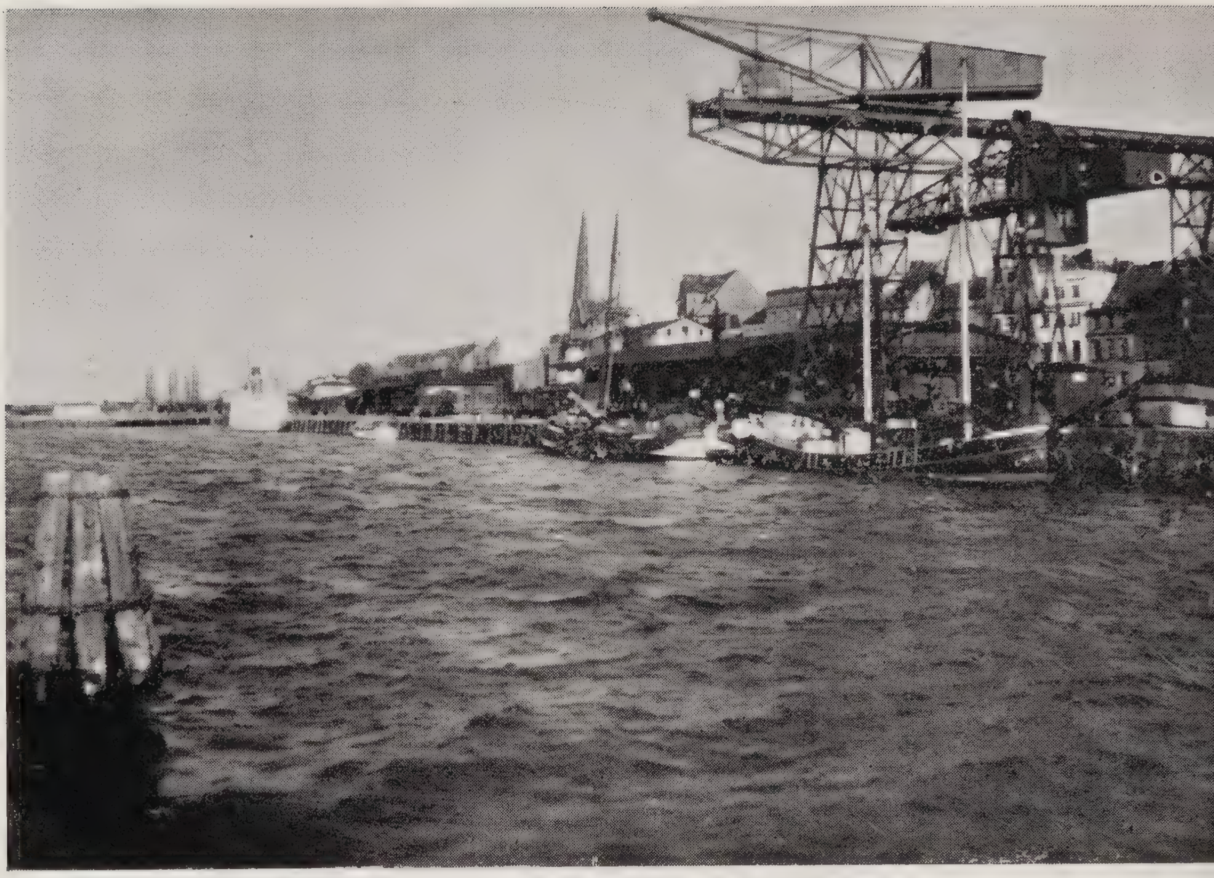

Plate 31. Rostock: river Warnow, looking east

Plate 32. Sassnitz: train ferry berths

to a least depth of 13 ft. over a width of 160 ft. Work had begun in 1938 to deepen this channel to 20 ft. The south-eastern channel from Greifswalder Bodden is about 14 miles long, and is dredged to a least depth of 16 ft. over a minimum width of 55 yds. Where the channel enters the strait between Rügen and the mainland it follows closely the coast of the former off Palmer Ort, widens between Glewitz and Stahlbrode, then winds north-westward, and finally passes east and north of Dänholm island to Stralsund. The openings between the mainland and Dänholm and between Dänholm and Rügen are now crossed by the Rügendamm (see p. 150).

Anchorage is available in Stralsund road outside the northern entrance to the harbour in depths of 5 to 6 fm. Pilotage is compulsory for all vessels proceeding through the Kubitzer Bodden to Stralsund, and for all vessels over 53 net registered tons (150 cubic metres net capacity) proceeding to that port from Greifswalder Bodden.

Ice often forms in the calm sheltered bays between Rügen and the mainland at the end of November or early December, but the main winter ice forms in January and lasts until the end of February. In ordinary winters there is no large area of fast ice, but in cold calm weather it sometimes extends a short distance from the coast until broken up by winds and currents. Ice forms quickly in the Gellenstrom and Stralsund channels; the average number of days closed each winter is twenty-seven (average of ten years), although in a hard winter it may be twice as long. Very occasionally the port and channels remain ice-free.

Detailed Description

Stralsund harbour, which fronts the eastern side of the town, is protected on the south-east by Dänholm island, from the north-western end of which projects a dog-legged breakwater nearly 1,100 yds. long. The North Mole, about 480 yds. long, projects eastwards from Stralsund island towards the breakwater; between the mole and the breakwater is the main entrance to the harbour, approached by a dredged channel 130 ft. wide and 16 ft. deep from the anchorage in the roadstead. The harbour is bounded on the south by the Rügendamm. The enclosed area of water is about 91 acres in extent, and the quays along the eastern waterfront of the city total 6,900 ft. in length, with depths alongside of 16–18 ft. The inner harbour or Langer-Hafen is a small enclosed basin, with depths of 6½ to 8 ft., entered from the outer harbour between

short moles; this entrance is crossed by a bridge carrying the main quay railway sidings, and the road along the waterfront. To the south of the Rügendamm is the Ziegelgraben or fishing harbour, protected by two short breakwaters. The southern part of Dänholm island is cut through by a canal, 9½ ft. deep, which traverses a rectangular basin bordered by storehouses and sheds, used by the naval and military establishments on Dänholm.

Port Facilities

Stralsund has considerable storage facilities along the waterfront of the main harbour, as well as those on Dänholm island. There are about 15,500 sq. yds. of covered storehouses and sheds, five large grain silos with modern mechanical equipment and a capacity of about 20,000 tons for grain, some 9,500 sq. yds. of fenced storage space for coal and wood, and the same amount of open storage space.

There are two yards for the building and repair of small vessels, including dredgers, tugs and ferry steamers; both are situated near the southern end of the main harbour. The *Staatswerft und Eisenbahn Verwaltung* has a slip to take vessels 115 ft. long, while the *Schiffswerft Otto Fröhling* had two slips 170 ft. long (these are no longer visible). Two engineering firms (see p. 149) make castings for and repair boilers and machinery. The *Krüger Werft*, just to the south of the Ziegelgraben and opposite Dänholm island, makes small craft.

Lifting appliances comprise a 25-ton crane at the *Staatswerft*, two cranes to lift 2½ and 3 tons in the outer harbour, a 4-ton crane in the Langer-Hafen and a coal-handling bridge with a slewing crane of 5 tons capacity.

The Town

Stralsund lies in the *Regierungsbezirk* Stettin of the Prussian province of Pomerania. Until 1932 the town was the headquarters of the administration of the *Regierungsbezirk* Stralsund which has now been incorporated in the *Regierungsbezirk* Stettin.

Stralsund is situated on the west bank of the channel—the Strelasund—which divides the island of Rügen from the mainland. Since 1936 the island of Rügen has been linked with the mainland at Stralsund by the Rügendamm (see p. 150).

In the first half of the thirteenth century two settlements were founded in the three-cornered island lying between the Strelasund, the Knieper Teich and the Franken Teich. The first settlement

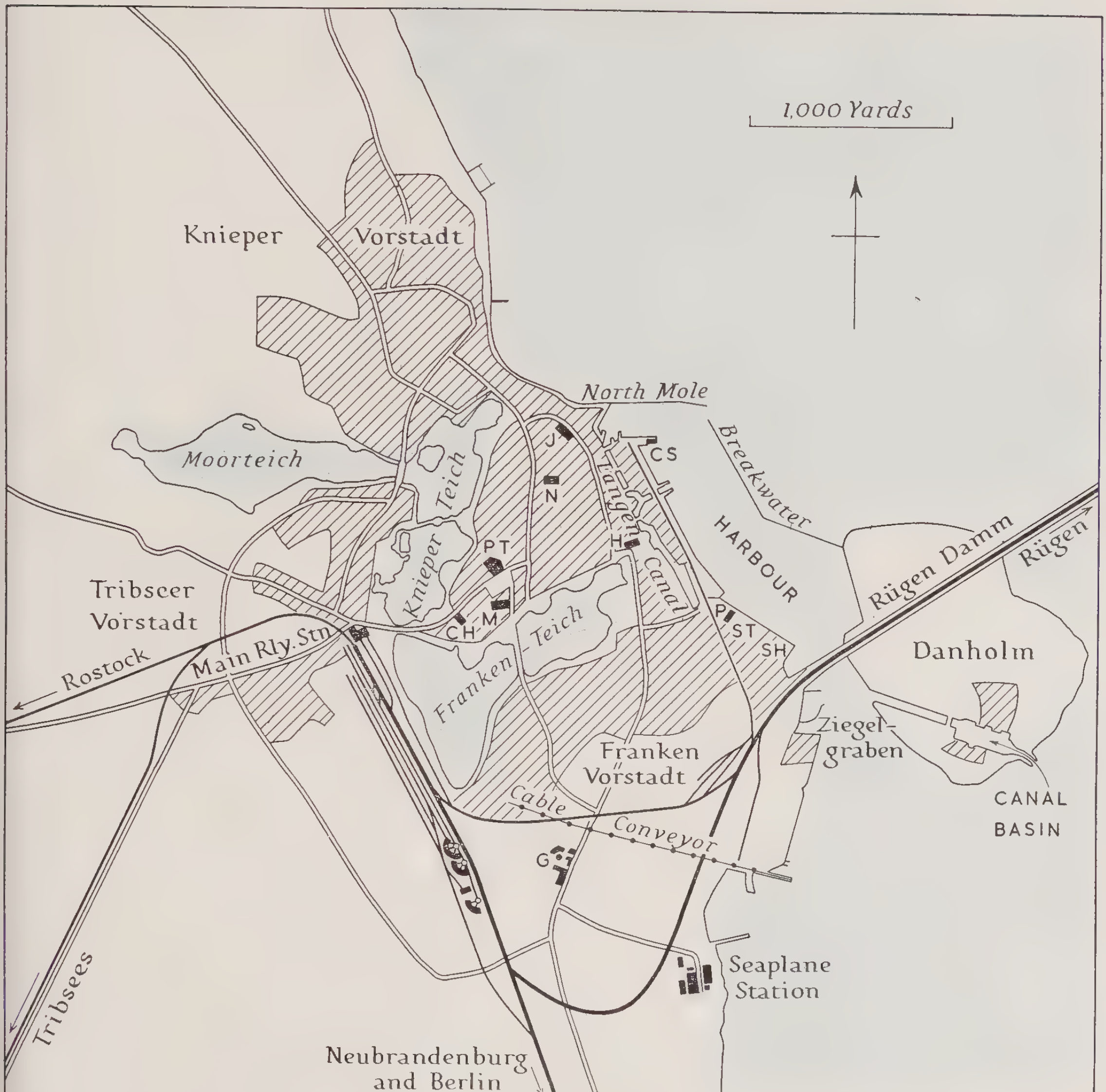

Fig. 35. Stralsund

Based on official sources.

CH Customs house; CS Customs shed; G Gasworks; H Heiliggeist-Kloster; J Johannis-Kloster; M Marien-Kirche; N Nicolai-Kirche; P Power Stn; PT Post and Telegraph Office; SH Harbour authority's shipyard; ST *O. Frühlings* shipyard

Fig. 36. Rügen, Stralsund and Sassnitz

Based on official sources.

Double-track railways are shown by thick line, single-track by a thin line.

of 1234 lay to the north of the island round the old market and the *Nikolaikirche*. The second settlement of 1240 grew up by the new market and the *Marienkirche*. These two settlements formed the original *Altstadt* which was destroyed by fire in 1272. The town was rebuilt and the network of roads then laid out survives to-day. The thirteenth-century walls were strengthened in the seventeenth century. In the middle of the nineteenth century the harbour district developed to the east of the old town beyond the walls. A moat (once used for defensive purposes) was turned into a canal to link the centre of the town with the basins (1862–72). Then the fortifications—which had been rebuilt after having been destroyed during the French occupation at the time of the Napoleonic Wars—were removed. The island of Dänholm was fortified.

New suburbs now sprang up beyond the lakes which had so long been the limit of urban expansion. These suburbs were the Knieper Vorstadt to the north; the Tribseer Vorstadt to the west (around the main railway station); the Franken Vorstadt to the south-east; and Dänholm island. Three bridges cross the three lakes (Moorteich, Knieper Teich and Franken Teich) to join the modern suburbs to the old town in the centre. A road runs on the Tribseer Dam which divides the Knieper Teich from the Franken Teich. The Rügendamm links the suburb of Dänholm island with both Stralsund and Rügen Island.

The most notable old buildings are the Town Hall, the *Nikolaikirche*, the *Marienkirche* (all built in the thirteenth and fourteenth centuries); the *Johanniskloster* and several gates and towers of the seventeenth-century fortifications. In the Town Hall are the provincial antiquarian museum and the municipal library.

Stralsund has administrative functions in the Reich, and is the seat of Reich offices for finance, customs, central banking and fisheries. The town is a municipal borough (*Stadtkreis*) about 14 sq. miles in area. Much of Stralsund's modern economic importance is due to the fact that it is a centre of communications between Berlin and Sweden. Traffic from the Reich to Sweden now uses the Rügendamm to the island of Rügen.

History

The first German settlement at Stralsund was made at the end of the twelfth century. The town was granted municipal rights by Wislaw I of Rügen in 1234. Towards the end of the thirteenth century Stralsund became a member of the Hanseatic League and

embarked upon a prosperous commercial career. The trade in herrings became especially important. At Stralsund was signed the Peace of 1370 between the Hanseatic League and Waldemar Atterdag of Denmark which for many years secured for the Hansa the political and economic supremacy of the Baltic. Stralsund, although under the rule of the Dukes of Pomerania, secured for herself a position of semi-independence.

With the decline in the importance of the Baltic trades and the collapse of the Hanseatic League Stralsund's commerce was much less important in the seventeenth and eighteenth centuries than it had been in medieval times. The port became a pawn in the political and religious rivalries of the Northern Powers. In the Thirty Years War Wallenstein suffered heavy losses before he gave up the siege of Stralsund which had lasted from 13 May to 24 July 1628. The town passed into Swedish hands at the peace of 1648. Thirty years later the Great Elector of Brandenburg succeeded where Wallenstein had failed. He besieged Stralsund and captured it, but was forced by Louis XIV to restore it to Sweden. During the Northern War Sweden once more lost Stralsund (1715) and again recovered it. During the Napoleonic Wars Marshal Brune took Stralsund; the patriot Ferdinand von Schill led an abortive rising against the French and lost his life. By the Peace of Kiel the town passed to Denmark, and finally in 1815 it fell to Prussia.

Immediately after the Napoleonic Wars the grain trade was depressed, partly because of the stringent British Corn Laws. In the thirties and forties there was some improvement in shipping and commerce as communications between Pomerania and other parts of Germany were improved and as economic unity was attained. In the early sixties Stralsund was linked by a branch line with the railway from Berlin to Stettin. After the unification of the Reich (1871) some industries developed in Stralsund. The most important were the construction of agricultural machinery; shipbuilding; the construction of vehicles; fish curing; paper making; distilleries and sugar refineries. The importance of Stralsund as a railway centre also increased, for through it passed an important traffic to the island of Rügen (where several seaside resorts developed) and also to Sweden (via Sassnitz).

The population of Stralsund increased as follows in the twentieth century:

1905	31,813	1933	46,635
1925	37,980	1938	47,600

Trade

The following figures summarize the trade of Stralsund for 1936 and 1937, the latest yards for which statistics are available:

	Coastwise		Foreign		Total
	Outwards	Inwards	Exports	Imports	
1936	70·1	41·7	60·4	54·7	226·9
1937	53·3	42·8	53·0	39·7	188·8

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

No detailed figures are available of the trade of Stralsund, as its returns are included in those of the 'Other Pomeranian ports' traffic district. Its total trade is less than half that of Sassnitz, the most important port in the region. Exports as a rule exceed imports by weight. The chief imports are coal, maize, stone (chiefly chalk and limestone), timber for pulping, and basic slag and other fertilizers. Exports comprise rye and oats, grain, flour, cement, lime and refined sugar.

Industries

There are three yards at Stralsund which engage in the construction and upkeep of dredgers, tugs and ferry steamers: the *Krüger Werft*, the *Staatswerft und Eisenbahn Verwaltung*, and the *Schiffswerft Otto Fröhling* (see p. 146). Two firms, the *Pommersche Eisengiesserei* and *Maschinenfabrik C.A. Beng*, make castings for and repair boilers and machinery.

There is a large sugar refinery south of the town near the southern end of the Franken Teich, which can handle 4,100 tons of beet a day. Other industrial concerns include a large lime-works and a brewery.

Communications

Railways. Stralsund is an important railway junction, as several lines converge on it carrying traffic to Sweden. The main line station is situated on the western shore of Franken Teich, near the Tribseer Damm, which leads across to the main part of the town on the island. The harbour station is in the Franken Vorstadt, and Rügendamm station at the western end of the causeway leading across to Rügen. The port is served by a line which runs north from the harbour station along the main waterfront.

A double-track line runs south-east to Berlin via Anklam, Pasewalk

and Angermünde. Pasewalk is the junction for Stettin. A single-track main line runs south via Demmin to Neustrelitz, where it continues as a double-track to Berlin. Two single-track lines link Stralsund with Rostock, one to the north via Damgarten and Ribnitz, the southern one via Tribsees. From the former, the *Darssbahn* branches off to Barth, Zingst and Prerow. A main single-track railway crosses the Rügendamm by way of Dänholm island to Rügen, crossing this to Sassnitz, from whence runs a train-ferry service to Trälleborg in Sweden. The recently constructed Rügendamm, 1½ miles long, carries both the railway and a motor road. Between Dänholm and the mainland the bridge has two openings and a central drawbridge, while from Dänholm to Rügen there is a flying bridge with nine spans.

A light railway station adjoins the main station on the shores of the Franken Teich. From this a light narrow-gauge railway winds westwards to the south of the Grabow and the Saaler Bodden, via Barth and Saal, to its terminus at Damgarten on the Stralsund-Rostock main line. A branch leads to Klausdorf.

Inland Waterways. None.

Roads. See Fig. 17.

Sassnitz (Fig. 36; Plate 32)

54° 31′ N., 13° 38′ E. Population: 6,000 (1935)

Sassnitz is situated near the north-eastern extremity of Rügen island. It is the terminus of the ferry service to Sweden (Trälleborg), being linked to the mainland by the Rügendamm; it is also much used as a port of refuge, and has a considerable importance as a fishing harbour. It lies in the *Kreis* Rügen of the *Regierungsbezirk* Stettin of the Prussian province of Pomerania. In 1906 Krampas was incorporated with Sassnitz.

Approach and Access

The harbour, situated on the south-eastern side of Jasmund peninsula, has a straightforward approach in deep water, unencumbered by obstructions. The entrance lies between two moles on the southern side of the harbour, with a depth of 4 fm. in the approach and 3½ fm. in the entrance. Anchorage is available in Sassnitz Road abreast of the town in depths of 6½–7½ fm. Pilotage

from the roadstead into the harbour is compulsory for merchant vessels over 53 net registered tons (150 cubic m. net capacity).

Detailed Description

Sassnitz harbour is wholly artificial, being enclosed by two moles. The longer east mole runs south-westward, more or less parallel to the shore at a distance of 250–350 yds. from it; it is about 1,600 yds. long and has five obtuse-angled bends. The west mole projects south-eastwards for 380 ft. towards the end of the east mole, leaving an entrance channel 137 yds. wide. Two large wooden landing stages for ferry boats project from the northern side of the harbour. Depths in the western part of the harbour are about 22 ft., in the centre of the harbour 16–20 ft., and in the eastern part 8–13 ft. Depths off the main quay decrease from 16–20 ft. at the western end to 10 ft. in the north-eastern corner, and off the eastern mole from 8½–11 ft. There is a small motor-boat pier to the east of the root of the main mole.

Port Facilities

No details are available of warehouses and of other storage accommodation, although there is considerable stocking space for bunker coal and for chalk and timber, two commodities which are exported.

There is a small slip for fishing craft up to 50 tons capacity, and repairs to the hulls and machinery of small vessels can be executed. On the south-east quay, which is reserved for naval vessels, there is a 40-ton crane.

Trade

The following figures summarize the trade of Sassnitz for 1936 and 1937, the latest years for which statistics are available:

Trade, 1936, 1937 (*in thousands of tons*)

	Coastwise		Foreign		Total
	Outwards	Inwards	Exports	Imports	
1936	184·4	21·7	95·3	85·1	386·5
1937	182·7	26·8	139·8	84·6	433·9

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

No detailed figures are available of the trade of Sassnitz, as its returns are included in those of the 'Other Pomeranian ports' traffic district. Its total trade, swollen by the rail-ferry traffic, was

nearly twice as great as that of Stolpmünde, the next most important port in this region; the foreign trade, however, consisted entirely of goods carried by the train ferry between Sassnitz and Trälleborg in Sweden. Imports comprise mainly coal, building materials and miscellaneous retail goods, while exports comprise chalk from the Rügen quarries, for cement and lime manufacture, and beech-wood, which is used extensively for smoking fish.

Industries

Sassnitz is mainly a holiday resort; several hotels cater for this trade. Industry, apart from the small ship-repairing yards (see p. 151), is of little importance.

Communications

Railways. Sassnitz is the rail-ferry port for Trälleborg in Sweden. A single-track main line crosses Rügen and the Rügendamm to Stralsund on the mainland, which is the focus of several main lines (see p. 149). The town station lies to the north of the town, while a spur line curves round to the ferry berths. There are several sidings along the quays.

A single-track line branches from the main line across Rügen at Bergen, and runs to Putbus on the south coast. There are two narrow-gauge lines in Rügen; one runs along the south coast from Altefähr to Göhren, the other serves the northern part of the island.

Inland Waterways. None.

Roads. See Fig. 17.

STETTIN WITH SWINEMÜNDE (Figs. 37–39; Plates 34–36)

Stettin 53° 23′ N., 14° 32′ E. Population: 270,747 (1933); 274,000 (1938)

Swinemünde 53° 55′ N., 14° 16′ E. Population: 20,514 (1933)

Stettin is the largest German Baltic port, and in trade and shipping is surpassed only by Hamburg and Bremen-Bremerhaven. It is the outlet, via the Oder, for much of the trade of the industrial region of Silesia and indeed of much of eastern Europe, and has itself important industries, notably shipbuilding. The port stands 45 miles up the Oder from Swinemünde, its outport, on the Swine, the central distributary of the Oder. Swinemünde is normally a main German destroyer and torpedo-boat base.

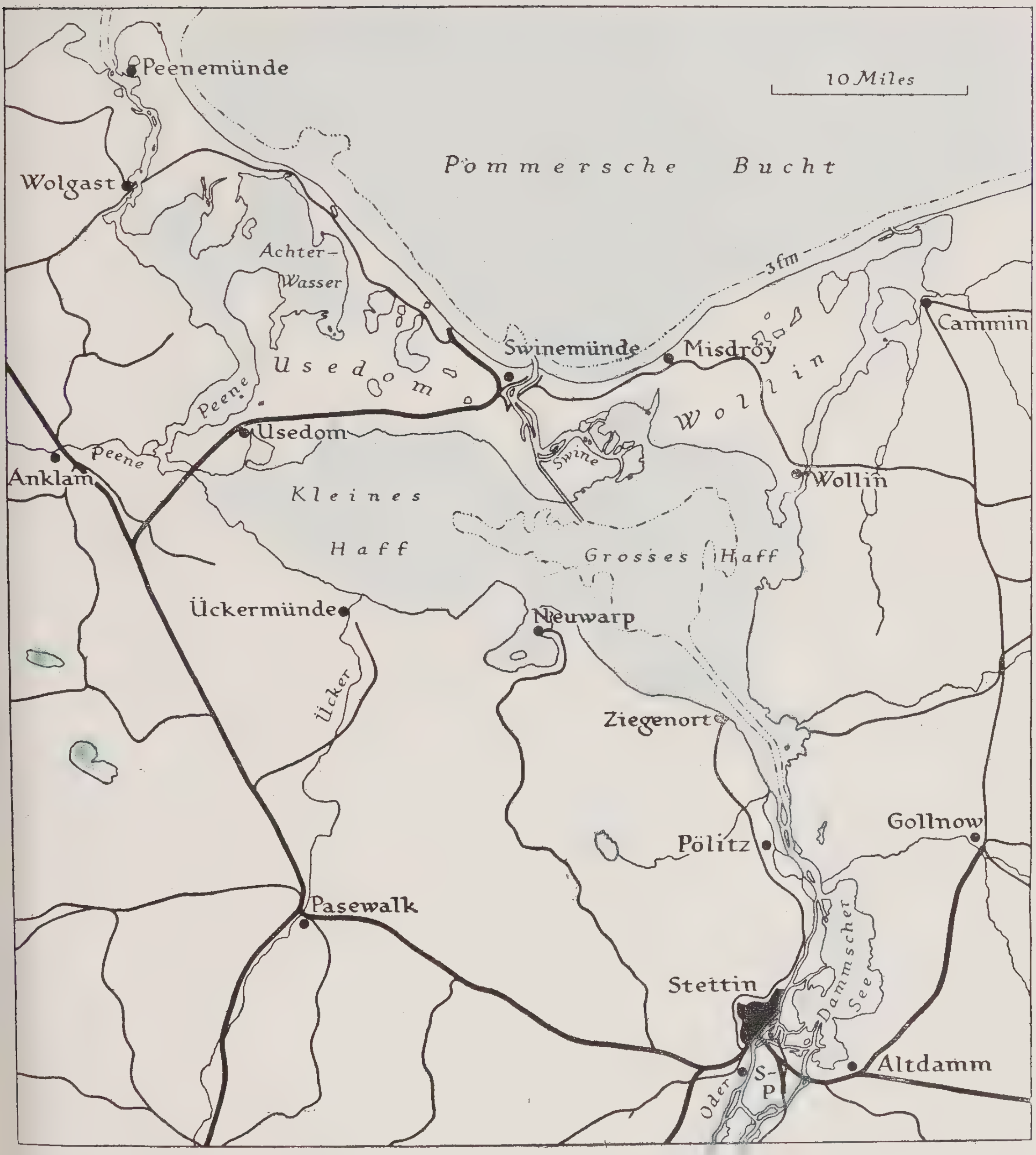

Fig. 37. The approaches to Stettin
Based on official sources.
S-P Stettin-Pommerensdorf.

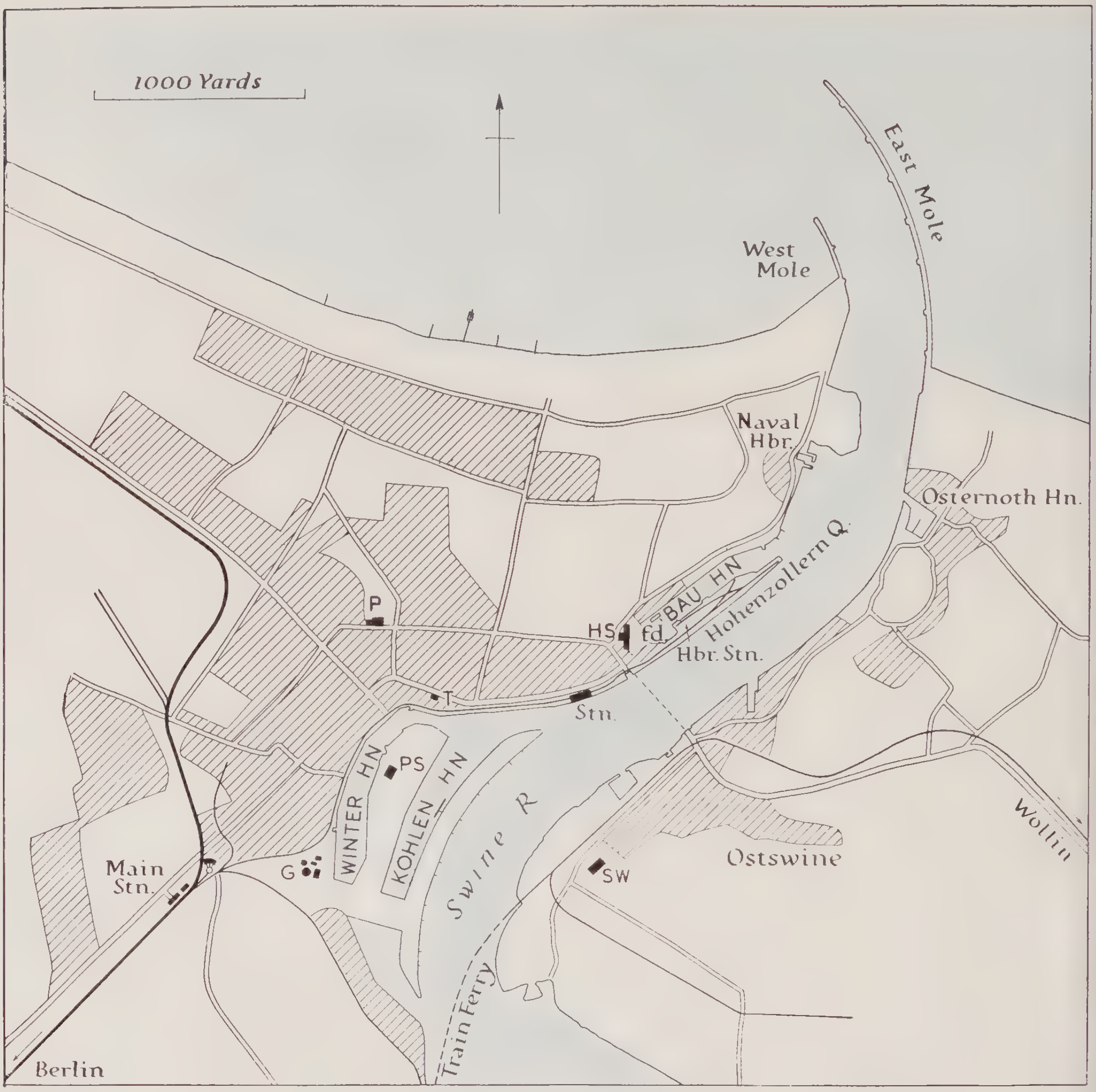

Fig. 38. Swinemünde

Based on official sources.

fd. Floating dock; G Gasworks; HS Harbour authority's shipyard; P Power station; PS *Pommern* shipyard; SW *Hermann Siebert* steelworks; T Town Hall.

Approach and Access

The harbour of Swinemünde is approached from the Pommersche Bucht, a broad open bay in the southern Baltic, through Swinemünde Road. The latter affords good anchorage in depths of 5–5½ fm., about 1½–2 miles north of the head of the eastern breakwater. The entrance to the river Swine is protected by two stone moles, which project in a north-north-westerly direction, the eastern for about 1,500 yds., the western for 300 yds. The latter stands on a bank named Westergrund, which forms the western side of the entrance channel and extends, with depths of 1–3 fm., for a distance of about 1,600 yds. north-north-westward of the outer end of the mole. This bank also extends inside the western mole to the west of the shipping channel, where it is known as Joachims Fläche. In the approach to the harbour and between the moles as far as the main lighthouse, the fairway is 328 ft. wide with a least depth of 32½ ft., thence to the southern end of Eichstaden (formerly an island), off Swinemünde, it is 492 ft. wide, with similar depths. The harbour of Swinemünde extends from near the southern end of the east mole to the southern end of Eichstaden.

The main buoyed channel between Swinemünde and Stettin is 37 miles in length, and has a least depth of 29½ ft. Above Swinemünde the channel follows Mellin Fahrt, on the west of Grosser Mellin island, which splits the Swine into two channels. South of this island the shipping channel leaves the Swine and follows the more direct Kaiser Fahrt, a canal 3½ miles long, into Grosses Haff, the eastern bay of Stettiner Haff. A dredged channel, 10½ miles long, with a bottom width of 157 yds., known as Haff Rinne, crosses the Grosses Haff in a south-easterly direction to Papen Wasser, the broad mouth of the main Oder river. The channel then crosses Papen Wasser, continues southward through Weite Strewe, a channel between the east bank of the river and Gross Korf Werder and Schmaler Werder islands, and then through the Damanscher Strom and the Schützen Werde cut; this part of the channel has a bottom width of 103 yds. The last section of the channel, along the Oder river into Stettin, has a bottom width first of 105 yds., then of 87 yds. The extensive Dammscher See, a sheet of water some 8 miles long and 1–2 miles wide, is separated from the main Oder channel by a low-lying island, the Grosses Oder Bruch, although there are several broad but shallow connecting channels. Stettin harbour lies on both banks of the Oder and of its subsidiary channels.

The western, but much less important, approach to Stettin, is through the Peene river channel, the western branch of the mouth of the Oder, which is 29 miles in length from the sea to where it enters the Kleines Haff. The dredged channel leads through several large bays and across numerous banks and shoals. The channel is dredged to $16\frac{1}{4}$ ft. with a width of 44 yds. as far as Wolgast Hafen, but from Wolgast into the Kleines Haff the depth is only $7\frac{1}{2}$ ft., with a width of 38 yds. In the fairway between the southern end of the Peene and the entrance to the channel connecting Kleines and Grosses Haff there are depths of 7–17 ft.; in this channel itself, and thence to the main shipping channel (Haff Rinne) between Swinemünde and Stettin, there is a least depth of 19 ft.

Pilots are compulsory for all merchant vessels, except for certain German vessels proceeding from Swinemünde Road to Swinemünde and thence to Stettin. The channel is kept open from the sea to Stettin by ice-breakers as long as the central and western parts of the Baltic are not closed by ice.

Detailed Description

Swinemünde. The harbour extends along both banks of the river Swine, from a point south of the southern end of the east mole to the southern end of Eichstaden harbour, with a total length of quays about 18,000 ft. Since 1938, considerable improvements have been carried out in the port; the following description includes details of these alterations wherever information is available. It may be noted that figures of depths are subject to the fact that heavy north-easterly gales may cause a rise of $6\frac{1}{2}$ ft., and southerly gales a fall of $3\frac{3}{4}$ ft. On the eastern side of the river is the small Osternoth-Hafen, with depths of 10 ft.; quays extend southwards from this basin to the naval basin, with depths of 23 ft.; further quays, interrupted by a small boat basin, continue southwards as far as the Swinemünde-Ostwine train ferry, with depths of 16 ft. On the left bank of the river, opposite the naval basin, is the important Hohenzollern quay, with over 23 ft. of water alongside; behind this lies the Bau-Hafen, 700 yds. long, opening at its north-eastern end into the river. Since 1938, a bridge across the Bau-Hafen has been removed, the basin widened, and the former second entrance at the south-western end closed. Quays with 18–24 ft. of water alongside extend from the Hohenzollern quay to the Winter-Hafen. Prior to 1938, Grüne Flache and Eichstaden islands lay in the bend of the Swine; between the left bank of the Swine and the west bank of Grüne Flache was

the Winter-Hafen, and between the two islands the Kohlen-Hafen. A boat harbour was excavated at the southern end of Grüne Flache. Since 1938, a broad dam has been constructed from the southern end of Eichstaden to Grüne Flache and beyond to the mainland, thus converting the two subsidiary river channels into basins, with entrances at the north-east. The boat harbour has been filled in, and new quays constructed on either side of the Winter- and Kohlen-Häfen. A seaplane base has been built south of the new dam. Depths in the Winter-Hafen prior to 1938 were 13 ft., and in the Kohlen-Hafen 13–16 ft., but these depths have probably been increased. Deep draught vessels can secure to dolphins off the eastern side of Eichstaden.

Stettin. The harbour of Stettin, which lies east of the town, comprises the main channel of the Oder (the old harbour), together with the straightened and deepened channels of the Dunzig and Parnitz distributaries which branch from the Oder and flow eastwards into the Dammscher See. There are, in addition, numerous artificial cuts, which divide up the low-lying land between the Oder and the Dammscher See into several straight-sided islands (Fig. 37). Thus the Möllenfahrt forms a direct link between the Unter-Oder and the Industrie-Hafen, the Dunzig-Parnitz Kanal connects the Dunzig with the Parnitz, and the Oder-Dunzig Kanal connects the Unter-Oder with the Dunzig and provides the most direct way into the Frei Hafen. The following table summarizes the depths in the various channels:

	Ft.		Ft.
Oder channel	20–28	Dunzig-Parnitz Kanal	26
R. Dunzig (western part)	29	Parnitz Durchstich	19
R. Dunzig (eastern part)	28	Möllenfahrt	29
Oder-Dunzig Kanal	28	Stich Kanal	28½
		Breslauerfahrt	26

These numerous channels, together with the basins (notably the east and west basins of the Frei Hafen; the Steinbruch, Netze and Warte basins of the Industrie-Hafen; and the Reiherwerder-Hafen), are fronted by a very considerable length of quay, estimated to total 20 miles. The most important commercial quayage is distributed as follows:

Quayage	Length, ft.	Depths alongside, ft.
Frei Hafen (east and west basins)	11,000	28 (reported 32½ ft.)
Dunzig Kai	2,300	29
Reiherwerder-Hafen	2,000	29
Industrie-Hafen	8,200	29
Old harbour (main Oder channel)	26,000	20–23

The Oder is crossed within the port area of Stettin by three lifting bridges—the Baum-, Hansa-, and Bahnhofsbrücken. These have openings of 57 ft. and a clearance of 13 ft. above mean water level when closed. There is also the railway swing bridge between the Baum- and Hansabrücken, which has an opening of 39 ft. The Parnitz is crossed by a lifting bridge with an opening of 57 ft. and by two railway swing bridges with openings of 41 ft. The Grüner Graben, a small cut between the Oder and the Parnitz, is crossed by a lifting bridge with an opening of 32 ft.

There have been a considerable number of schemes to extend the port area of Stettin. The main long-term project, on which work had not been started in 1939, is the construction of seven large basins on the site of the present islands of Der Fette Ort and Mölln-Revier; access to each of these will be direct from the Möllenfahrt. In 1938, extensions to the Reiherwerder-Hafen were begun; these included a new large basin and a marshalling yard. As this extension is intended primarily to accommodate part of the port's great coal trade, modern coal-handling equipment is to be installed. The execution of this scheme was expected to take six years from 1938. The marshalling yard has been completed, but not the large basin.

Port Facilities

Swinemünde. The main freight-handling area is along the Hohenzollern quay, the waterfront to the south of it, and the western shore of the Winter-Hafen. No details are available of storage accommodation. The naval base has extensive stores and maintenance yards.

There are three shipyards. The Harbour Authorities Shipyard, which undertakes small repairs, has a floating dock, and several patent slips, of which the dimensions are not known, in the Bau-Hafen. The *Pommern* shipyard, on the western side of Grüne Flache, can undertake various small repairs and castings, and has a patent slip to take vessels up to 4,400 tons. There is also the small *Mahr* shipyard on the northern end of Grüne Flache; no details are available of its activities. Since 1942 small drifter-type fishing vessels (80-ft. 'Swinemünde drifters') have been built in two small yards at Movenhaken, on the east bank of the Swine opposite Eichstaden. Lifting appliances at Swinemünde comprise a 30-ton sheers, a 16-ton crane, and several smaller cranes. (At the end of 1944 a second floating dock was visible.)

Stettin. There are extensive storehouses and handling equipment

to accommodate the bulk goods of which Stettin's commerce largely consists (see p. 165), especially round the Frei-Hafen, the Industrie-Hafen, and the Reiherwerder-Hafen. At the northern end of the Oder-Dunzig Kanal, leading into the Frei-Hafen, is a modern grain storehouse and silo, built in 1935–6; the storehouse, consisting of two blocks, each ten storeys high, has a capacity of 43,000 tons. To unload from the ships alongside the quays there are two travelling suction elevators with conveyor belts, each with a capacity of 100 tons per hour; on the land side are eight conveyor belts and four tubes, each of 100 tons per hour capacity, used for transferring grain from the storehouses to vehicles. A third block, with a capacity of 12,500 tons, was under construction in 1939. The Frei-Hafen and Dunzig quayage is equipped with ten quay sheds, with a total covered area of about 48,000 sq. yds., a six-storey shed warehouse with about 24,000 sq. yds. of covered area, refrigerating plant, etc. There is also a large warehouse-granary, constructed in 1928–9, near the east side of the west basin; it is of reinforced concrete on 4,557 wooden piles, five storeys high, with a capacity of 65,000 tons. The building has a length of 690 ft., a breadth of nearly 127 ft., and a height from the cellar to the roof of 71 ft. On the quayside are two railway tracks, on the landward side three, and there is a ramp for road traffic. At the front of the building are eight portal cranes, inside are four lifts for heavy goods and spiral conveyors for the quick handling of bagged materials and grain. On the flat roof are three transporter-type lifting cranes. Many large industrial concerns have their own storage accommodation in the harbour area.

Stettin is a considerable shipbuilding port, and it is reported that four concerns were engaged. The most important is the *Stettiner Oderwerke A.G. für Schiff- und Maschinenbau*, whose yards and docks are situated on either side of the Oder below the port, both on the mainland and on Bredower Werder. The company is reported to own four floating docks, two of which have two compartments each and could be used jointly or individually.

Length, ft.	Lifting capacity (tons)	
238	2,850	5,000
178	2,150	
165	1,500	2,700
131	1,200	
102	1,000	
99	700	

The floating dock equipment in December 1944 was more exten-

sive, however, and comprised 13 docks, of the following dimensions, in ft.:

Length	Width	
505	70	
410	60	
320	50	
296	52	(two sections, 131 and 165)
250	58	
250	40	(five; one sunk. Daughter type
245	40	without self-pumping
150	52	machinery)
95	60	

The yard also has four slips, three of which are about 460 ft. in length, while the fourth is stated to be capable of taking two ships of 590 ft. simultaneously. Normally the yard built small merchant vessels. In 1939 the *Stettiner Oderwerke* absorbed the *Merkurwerft*, which lies to the south of the main yard; work has been in progress on new buildings and quays since 1939.

The *Stettiner Vulkan Werke* (previously *J. Gollnow*) was reopened and reconditioned in 1938;* it lies along the left bank of the river below the *Stettiner Oderwerke*. According to reports, in 1942 there were four groups of slipways, with ten slips in all, either completed or under construction, of lengths 90–680 ft.

The *Ostseewerft Schiffbau- und Maschinenfabrik A.G. Frauendorf* is situated on the left bank of the Oder below the *Stettiner Vulkan Werke*; it formerly had four slips, the largest 430 ft. in length, but no building has been reported since 1937. It is reported that the site of the old *Wolheim Caesar Werft* of Stettin-Stolzenhagen, which had been taken over by the *Vulkan Werke* and closed in 1930, has been bought by the *Gassur Schiffswerke*, of Berlin-Friedrichshafen, and equipped for the repair and construction of river craft and small sea-going vessels. A further yard is listed by Lloyd's Register—*Greifenswerft G.m.b.H.* It was stated to have in 1939 two side slips 260 ft. and 180 ft. in length and of 1,000 and 400 tons capacity, and a longitudinal slip of 250 tons capacity.

The port is well equipped with lifting appliances, including stationary and travelling cranes, floating cranes, sheers, travelling grain elevators and transporter bridges. The Frei-Hafen has a total of 96 cranes to lift $1\frac{1}{2}$–40 tons, while 60-ton and 100-ton cranes have been reported. The Dunzig Kai has twenty electric travelling cranes of $1\frac{1}{2}$–5 tons. The Reiherwerder-Hafen has nine transporter bridges —four 5-ton, one 10-ton and four 15-ton, used for iron ore, coal and coke. The *Stettiner Oderwerke* yard has two 60-ton floating cranes.

* By the *Deutsche Schiff- und Maschinenbau*, after 10 years' inactivity.

The City

Stettin is a municipality (*Stadtkreis*) with an area of 29·5 sq. miles. The town developed at the lowest point on the Oder where firm land was to be found and where the river could be conveniently crossed. Below Stettin there were lakes—such as the Dammscher See—and marshes which made it difficult to cross the river or to find a firm foundation of which to build a town.

On the lower slopes of a plateau, reaching an altitude of 40 m. on the left bank of the river, a small Wendish fishing village developed. The site was probably on or near the present new market place. Around this nucleus the medieval German town grew up. Its walls may be traced on a modern street plan by following the Grüne Schanze in the south, the Parade Platz in the west, and the Königsplatz and Klosterhof in the north. The network of streets in this circular area was less regular than was customary in medieval German 'colonial' settlements east of the Elbe. This was because Stettin was built on the slopes of a hill which were broken by little valleys. Near the right bank of the Oder there developed the island suburb of Die Lastadie.

During the Napoleonic Wars some small suburbs that had developed beyond the walls were largely destroyed. Sack, the Senior President of the Prussian province of Pomerania, began the reconstruction of these districts soon after the French invaders had been driven off. But it was only after about 1840—with the coming of railways—that the modern expansion of Stettin began. Then there was urban development to the south around the main railway station. On the left bank of the Oder the Grüne Schanze divided the old town from such new suburbs as Oberwiek which lay between the railway and the river. On the right bank of the Oder the new urban area of the Silberwiese lay on an island formed by the Oder, the Parnitz (a tributary of the Oder), and the Grüner Graben.

After the strong fortifications had been removed in 1874 the urban area was considerably extended. To the north the district between the Grabower Strasse, the Kaiser Wilhelm Strasse and the Falkenwalder Strasse was built up. At Bredow the great Vulkan machine-making plants were set up. In the west there were new suburbs on either side of the Hohenzollern Strasse and the Berliner Strasse. To the south there was some urban expansion along the Hamburg-Berlin railway line. To the east new urban developments were along the Parnitz river. On the right bank of the Oder, east of the old Lastadie

suburb, the Free Port was built in the nineties. The Steinbruck Hafen and the Reiherwerder Hafen were opened between 1917 and 1919. The Lastadie and the Silberwiese have become dense concentrations of warehouses, timber yards, saw mills, coal dumps and small factories.

Notable buildings in Stettin include the thirteenth-century *Jakobi Kirche* (to which additions were made in the seventeenth and eighteenth centuries), the castle of the Dukes of Pomerania (1503–77; restored 1874); the early eighteenth-century baroque gates *Berliner Tor* and *Königs Tor*. The Municipal Museum has a section devoted to the history of shipbuilding with models of ships built at the famous local Vulkan yard.

Three bridges cross the Oder at Stettin—the Baum Brücke from the main part of the old town to the Lastadie suburb; the railway bridge which goes over the Oder, the Silberwiese island and the river Parnitz; and the Bahnhofs Brücke which is a road bridge running from the main railway station across Ahrens Island to the Holzmarkt (timber market) on the Silberwiese.

Stettin has administrative functions in the Reich and in Prussia. Among offices of the Reich in the city are those for finance (*Finanzamt*), customs (*Zollamt*), the post office (*Oberpostdirektion*), the railways (*Reichsbahndirektion*) and the army (*Wehrkreiskommando*). In Prussia Stettin is the administrative headquarters of: (1) The Province of Pomerania which is 11,686 sq. miles in area and has a population of 1,920,000. It is divided by the Oder into Vor Pommern and Hinter Pommern. (2) The *Regierungsbezirk* Stettin which has an area of 6,216·6 sq. miles and a population of 1,234,232 (1933). In 1932 the *Regierungsbezirk* Stralsund (1,550 sq. miles in area with a population—in 1925—of 246,940) was merged into the *Regierungsbezirk* Stettin.

Swinemünde. The outport of Swinemünde (population 20,521 in 1933) on Usedom island lies in the *Regierungsbezirk* Stettin of the Prussian province of Pomerania. It is situated on the left bank of the Swine, which is the principal channel linking the Stettiner Haff with the open sea. The town includes the villages of Osternothafen and Ostswine which lie on Wollin island on the right bank of the Swine. At Swinemünde are offices of the Reich for finance, banking, customs, fisheries, pilot services and seamen's welfare. Regular steamship services link Stettin with Danzig, Zoppot, Pillau, Rügen, Travemünde and Bornholm. The usefulness of Swinemünde as an outport for Stettin was greatly increased in the last years of the nineteenth

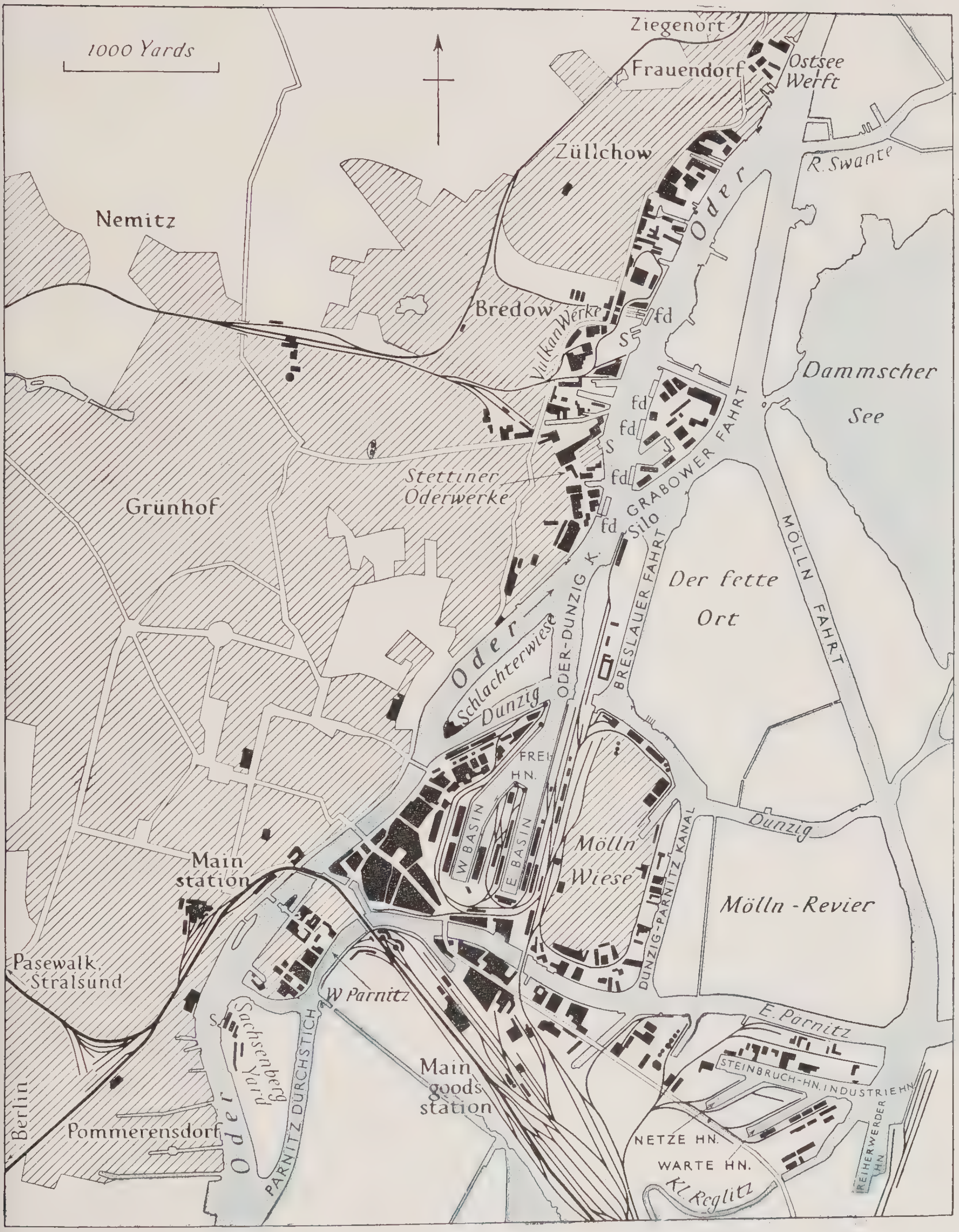

Fig. 39. Stettin
Based on official sources.
fd Floating dock; S Shipyard.

century by the construction of the Kaiser Fahrt which cut off many of the windings of the Swine channel.

History

In the middle ages Stettin was the chief town of Pomerania-Stettin, one of the three districts into which the Duchy of Pomerania was divided, the other two being Vorpommern and Hinterpommern. These three territories showed a certain stability despite temporary divisions, changing frontiers and the hostility of Denmark, Poland and Brandenburg. The Stettin branch of the ruling family died out in 1464 and ten years later all Pomerania was united. Between 1523 and 1625 the Duchy was again divided and then in 1637 the ruling family came to an end.

Stettin had been a member of the Hanseatic League in the middle ages and had secured a measure of municipal independence, but gradually the Dukes' hold upon the town increased. About 1530 Stettin lost the right to mint its own coins. Shortly afterwards its right to forbid the export of corn was drastically curtailed. But while the Dukes asserted their authority in this way they were prepared to go to great lengths to support Stettin in its disputes with towns outside Pomerania. In the years 1572–1653 the notorious economic rivalry between Stettin and Frankfurt-an-der-Oder led to a trade blockade between Pomerania and Brandenburg. Merchants, however, were able to circumvent the blockade to some extent. Stettin had an important trade in grain at this time.

When the ruling family died out in Pomerania, Brandenburg had claims to the succession, but the disputed territory was seized by the Swedes during the Thirty Years War. Stettin was of value to Sweden as a bridgehead from which to invade Germany. By the Peace of Westphalia (1648) the Great Elector of Brandenburg got most of Hinterpommern, but the Swedes secured part of this province (including Stettin) as well as the province of Vorpommern. In 1720, at the end of the Northern War, Sweden gave up the town and fortress of Stettin to Brandenburg-Prussia. In the eighteenth century the Prussian part of Brandenburg was divided for administrative purposes into the two *Bezirke* of Stettin and Köslin. The Hohenzollerns actively promoted the development of their new and important port. In 1729 the work was begun of improving the navigation of the Swine as an outlet from the Stettiner Haff to the Baltic. On the site of the old fishing village of West Swine a new settlement developed, and in 1765 Swinemünde secured municipal rights.

Stettin's trade and shipping were depressed in the years following the Napoleonic Wars and the French occupation of 1806–13. By 1814 many of the suburbs and neighbouring villages were in ruins. The finances of the town were in hopeless confusion, and the number of ships belonging to Stettin firms declined. In 1817 two Stettin merchants (H. Dohrn and J. F. Veltkusen) founded a sugar refinery—the *Pommersche Provinzial Zuckersiederei*—which later became a very flourishing concern. There was some progress in commerce when the Zollverein was established; when new main roads and railways were constructed; when the inland waterways were extended; and when the harbour installations of Stettin and Swinemünde were improved. The railway from Berlin to Stettin was completed in 1843. Some improvements were made on the upper Oder in the fifties, and again in 1891–7, and on the lower Oder in the eighties. In the nineties the Kaiserfahrt was constructed from the Stettiner Haff to the Baltic and in 1914 the Berlin-Stettin Ship C.* was completed so that 600-ton barges could now reach Stettin from Berlin by way of the Berlin-Spandau C., the river Havel, the Hohenzollern C. and the lower river Oder. Goods which had paid dues when passing through the Sound and were unloaded at Stettin for consumption in Prussia paid lower import duties than were charged if they came by another route.

In the first half of the nineteenth century Stettin played the characteristic role of the German Baltic ports at that time—it exported agricultural and timber products from eastern and northern Europe and imported manufactured articles and colonial goods from the West. In the early forties the most important exports were grain (wheat, rye, barley, oats); peas; linseed and rapeseed; timber; and spelter. Subsequently, as the Silesian and Berlin industrial areas expanded and as communications improved, Stettin handled manufactured products from these regions. In 1848 Stettin and Swinemünde owned 218 ships which represented 22·54% of the Prussian mercantile marine.

But Stettin suffered from the competition of Hamburg. The superior harbour facilities of Hamburg and the world-wide connexions of that port enabled it to attract trade which one might have expected Stettin and other Baltic ports to handle. In the nineties, for example, the traders of Breslau were beginning to use Hamburg as the port from which to import petrol and to export sugar; later, the corn merchants of Berlin came to draw rather less

* See p. 522.

grain from Stettin and rather more from Hamburg (via the Kiel C.). It was to meet this situation that the Stettin Free Port was built in the nineties and the Steinbruck and Reiherwerder harbours were constructed twenty years later. Again, in the years following the opening of the Berlin-Stettin Ship C. there was not an increase, but a fall in the traffic from the inland waterways handled by Stettin.

Important modern industries developed in Stettin after about 1870 and old-established industries expanded rapidly. These fell into two main groups. First, there were industries such as shipbuilding (the *Stettiner Vulkan Werft* and the *Stettiner Oderwerke A.G. für Schiff- und Maschinenbau*), which were associated with shipping and overseas commerce. The Vulkan shipyard had been established in the fifties, but owing to lack of orders it built locomotives for a time. Then in 1887 it secured a contract from the Hamburg-Amerika Line for a large twin-screw ocean liner and so embarked upon a prosperous career. In the early years of the twentieth century the Vulkan yard and plants were employing some 8,000 men. In 1900 the firm built the *Deutschland* (a Hamburg-Amerika Line ship which held the blue riband of the Atlantic for a time) and later it constructed the *Imperator* (at Hamburg) for the same line. Secondly, there were manufactures which arose from Stettin's position as the chief local market for the agricultural products of Pomerania. This group included beet sugar refineries (e.g. the *Baltische Rübenzuckerfabriken G.m.b.H.*), corn mills, breweries and distilleries. The timber, furniture and woodworking industries were also of some importance.

Several new branches of manufacture were started in the city. These included blast furnaces (e.g. the *Kraftwerk* concern which was linked with the Henckel-Donnersmark mines in Upper Silesia); the construction of motor vehicles (e.g. the *Stoewer Werke A.G.*); engineering works (e.g. the Vulkan machine-building plants); the making of cement (e.g. the *Stettiner Portland Cement Fabrik*) and fire-proof clay (e.g. the *Stettin Schamottenfabrik*); the production of refractory materials and catalysts (e.g. the *Didier Werke A.G.*); the manufacture of paper; the making of chemicals such as fertilizers; and the production of men's garments.

After the war of 1914–1918 Germany's territorial losses in the east—Danzig, the Polish Corridor and part of Upper Silesia—greatly depressed the shipping, trade and industries of Stettin. The rivalry of Gdynia (the new port of a revived Poland) and of the

Free City of Danzig made itself felt in a most disagreeable manner. The completion of two new harbours in 1917–19 and the improvement of communications with the capital of the Reich by the opening of the Berlin-Stettin Ship C. (1914) were no adequate compensation for the partial loss of a once-valuable hinterland and for the continued expansion of Hamburg at the expense of Germany's Baltic harbours.

Between 1912–13 and 1925–27 Stettin lost 1,137,000 tons of shipping traffic and 1,734,000 tons of goods traffic. In the same period the inland waterway traffic from the port to the Warthe and Netze declined by 149,010 tons and its traffic on the Oder with Silesia dropped by 436,613 tons. Whereas immediately before the war of 1914–1918 its total traffic was greater than the total combined traffic of Königsberg, Danzig and Lübeck, in 1927 Danzig alone had far outstripped Stettin in the volume of traffic which it handled.

Tonnage of Shipping using Stettin and other Oder Ports (*in tons*)

	Incoming ships		Outgoing ships	
	Laden	Empty	Laden	Empty
1909	1,387,924	48,407	934,536	532,232
1913	1,893,000	119,000	1,272,000	801,000
1926	1,466,000	1,253,000	2,172,000	553,000
1927	1,866,000	141,000	1,087,000	912,000

From: I. F. D. Morrow, *The Peace Settlement in the German Polish Borderlands*, p. 379 (Oxford, 1936).

Industries, too, suffered greatly after the war of 1914–1918. The Vulkan yard was closed down (to be re-opened only in 1938). The unemployed in Stettin numbered 11,888 (4·68% of the population) in March 1926. Before 1914 the Stettin sugar refineries obtained 9,000 tons of raw beet sugar a year from Posen and sent some 5,500 tons of refined sugar to Posen. This trade came to an end after 1918. Before 1914 one chemical factory alone sent fertilisers worth £86,100 a year to territories subsequently lost by the Reich to Poland. In 1927 its exports to these territories were valued at only £8,500. Two cement factories lost completely their trade with Posen and West Prussia. The sending of raw iron from Stettin to these territories—about 4,500 tons a year before 1914—virtually came to an end. Trade in manufactured goods and in salted herrings also suffered severely.

The Treaty of Versailles (1919) internationalized the river Oder and provided for the establishment at Stettin harbour of a free

port area for the exclusive use of Czechoslovakia. Since the Oder is not navigable in Czechoslovakia the proposed Czech free port was never set up.

The population of Stettin has increased as follows:

1816	24,500	1900	210,680
1838	31,100	1905	224,000
1855	60,000	1910	236,000
1871	75,000	1925	254,466
1885	99,475	1933	269,557
1890	116,228	1938	273,900

Trade

The following figures summarize the trade of Stettin for 1936 and 1937, the latest year for which statistics are available:

Trade 1936, 1937 (*in thousands of tons*)

	Coastwise		Foreign		Total
	Outwards	Inwards	Exports	Imports	
1936	2,134·2	1,608·7	1,993·7	2,631·7	8,368·2
1937	826·9	1,645·7	2,630·7	3,226·8	8,330·1

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

These statistics, and others in this section, refer to the *Verkehrsbezirke* (traffic district) of Stettin, which includes the harbour of Stettin itself and the following places in the *Kreis* of Randow: Pommerensdorf, Züllchow, Frauendorf, Altdamm, Finkewalde, Podejuch, Stolzenhagen, Gotzlow and Odermünde. Most of the commerce, of course, passes through Stettin itself, the others being of negligible importance.

The following table summarizes the main imports of Stettin in 1937:

	Tons		Tons
Coal	1,333,000	Oilseeds	94,461
Iron ore	947,403	Cellulose	90,384
Timber for pulping	306,043	Thomas slag	81,446
Maize	227,193	Pig iron and crude steel	73,784
Pyrites	166,586	Scrap iron	57,928
Mineral oil	166,069	Bauxite and cryolite	56,224
Coke	118,794	Barley	49,980
Sawn timber	112,388	Fish	46,344

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, pp. 8–17.

Stettin imported a total of over 100,000 tons from each of six countries, as follows:

	Tons		Tons
Sweden	933,063	Belgium	191,388
Netherlands	507,094	Latvia	187,027
Gt. Britain	311,873	Finland	111,715

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, pp. 8–17.

Of the 1·6 million tons of coastwise import, nearly a million tons came from the Ems ports. Most of this consisted of coal; in fact, of the 1·3 million tons of imported coal, 860,000 tons came from the Ems ports; Great Britain supplied 227,000 tons and the Netherlands 225,000 tons. Imports from Sweden consisted mainly of iron ore (950,000 tons). Latvia and Finland were the sources of timber and its derivatives; the former sent 53,000 tons of sawn timber and 113,000 tons of timber for pulping, the latter sent 29,000 tons and 41,000 tons respectively. The U.S.S.R. (84,000 tons) and Canada (53,000 tons) were also important suppliers of timber for pulping. Maize is imported primarily from the Netherlands and Belgium, pyrites from Italy and Norway, mineral oil from Mexico and U.S.A., oilseeds from Japan, bauxite from Jugoslavia and Greece, and basic slag from Belgium. The import of fish from Great Britain was considerable, and amounted to 26,000 tons.

Exports. The following table summarizes the main exports of Stettin in 1937:

	Tons		Tons
Coal	2,061,660	Cement and mortar	67,420
Coke	245,717	Rye and wheat flour	65,330
Sugar	156,442	Lignite	62,481
Wheat	82,872	Rye	47,274

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, pp. 8–17.

Stettin exported over 100,000 tons of goods to each of eight countries, as follows:

	Tons		Tons
Denmark	504,948	Norway	273,643
Netherlands	453,514	Finland	193,027
Italy	339,460	Jugoslavia	135,188
Sweden	307,691	Danzig	106,473

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, pp. 8–17.

These figures reveal the overwhelming dominance of the coal export; the total includes both coal from Silesia, which travels down the Oder, and re-exported Ruhr coal which comes coastwise from the Ems. Denmark took 380,000 tons, Italy 330,000 tons, and Norway 250,000 tons, while Finland, Sweden, the Netherlands, and Jugoslavia each took over 100,000 tons. The Netherlands also imported 115,000 tons of coke. There were few other outstanding items with individual countries. Some 120,000 tons of sugar went to the Netherlands, and nearly 150,000 tons of wheat and rye (both grain and flour) to the same country. Denmark took 24,000 tons of maize and 18,000 tons of oilcake for animal feeding stuffs.

The following figures summarize the trade of Swinemünde for 1936 and 1937, the latest years for which statistics are available:

Trade 1936, 1937 (*in thousands of tons*)

	Coastwise		Foreign		Total
	Outwards	Inwards	Exports	Imports	
1936	1·9	7·3	0·2	4·4	13·8
1937	3·0	18·6	—	7·7	29·3

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

Inward traffic consists mainly of bunker coal, fuel oil and fish; outward traffic comprises small shipments of coal to neighbouring minor ports.

Industries

Swinemünde. There are four shipyards at Swinemünde, the Harbour Authorities', the *Pommern*, and the *Mahr* yards (see p. 156). There is a small wood-impregnating plant.

Stettin. There is considerable industrial activity at Stettin, and it is reported that two important yards—the *Stettiner Oderwerke A.G. für Schiff- und Maschinenbau* and the *Stettiner Vulkan Werke*—and two smaller concerns—the *Ostseewerft Schiffbau- und Maschinenfabrik A.G. Frauendorf* and *Gassur Schiffswerke*—were in operation in 1943 (see p. 158). The output of these various yards included all types of vessels from motor boats and barges to merchant ships up to 4,500 tons and ice-breakers.

There is a wide range of miscellaneous industries carried on at Stettin, most of which are situated near the Oder waterfront. Metallurgical concerns include a blast-furnace plant with an annual capacity of 150,000 tons, and the *Pommersche Motorenbau* at Altdamm, east of the city, which makes aero-engines. Chemical works comprise the *A.G. der Chemischen Produkten-Fabriken*, one of the leading producers of phosphates, two Portland cement factories at Bollinken, a superphosphate plant at Stettin-Pommerensdorf, a chlorine plant at Odermünde, with a capacity of 1,500 tons per annum, and a soap factory. There are two distilleries of ethyl alcohol, a yeast distillery using molasses as raw material, and a brewery. Large paper, pulp and cellulose factories are near the Industrie-Hafen, at Odermünde, and at Hohenkrug. There is a synthetic oil plant at Pölitz (the *Hydrier Werke Pölitz A.G.*), on the

left bank of the river north of Stettin, with an estimated annual capacity of some 400,000 tons, a tyre-retreading plant, and brick-yards producing fire-proof bricks. There are several large flour-mills, mainly on the left bank of the lower Oder.

Communications

Railways. The complicated lay-out of the railways in and near Stettin can be seen from Fig. 39. The main passenger station for the city lies on the banks of the Oder opposite Silberweise island, while there is an important junction station some $\frac{3}{4}$ mile to the south of this at Pommerensdorf. A number of subsidiary passenger stations (Torney, Westend, Zabelsdorf, Bredow, Züllchow, and Freuendorf) serve the suburbs to the west and north of the city. The chief goods station, which has a marshalling yard with a handling capacity of 2,500 trucks per twenty-four hours, lies to the south-east of the city, on the peninsula between the Oder and the Parnitz. The smaller Grabow goods station is near the north of the city. The port is served by an extensive series of lines and sidings, known as the *Stadt Hafenbahn*; every important quay, in fact, has rail connexion (Fig. 39), and most of the larger warehouses, silos and petroleum tanks have their own sidings. The lines are as a rule carried across the numerous channels which intersect the port area by swing-bridges. The shipyards and industrial concerns along the left bank of the Unter-Oder (in the suburbs of Bredow, Züllchow, Frauendorf and Gotzlow) are served by lines which branch from the single-track railway between Stettin and Ziegenort on the shores of Papen Wasser.

From Stettin, double-track main line railways radiate south-eastwards via Stargard to Poznan (Posen) and Warsaw; south-westwards to Angermünde and Berlin; and north-westwards to Pasewalk, hence either to Stralsund, or to Rostock and Lübeck. Single-track main lines run northward to Cammin, then along the Pomeranian coast; eastwards to Köslin, Stolp and Danzig; south-wards to Küstrin and Frankfurt a.d. Oder; and northwards to Ziegenort.

The main railway station at Swinemünde is situated to the south-west of the town. Two smaller stations serve the harbour, and Bad station lies to the west of the town. A single-track line runs along the western shore of the Winter-Hafen to the Hohenzollern quay and the Bau-Hafen, where there are a number of sidings. A double-track main line runs via Karmin, where a bridge 550 yds. long spans

Plate 33. Stralsund: Marienkirche

Plate 34. Swinemünde, looking north-east

On the strip of land in the centre, Eichstaden, can be seen the power station. To the left lies Grüne Flache, and on the extreme left the winter harbour. Since this photograph was taken Grüne Flache has been joined to Eichstaden.

Plate 35. Stettin: the Oder, below the city, looking north-east
Across the river can be seen the new silo, before its completion.

Plate 36. Stettin: the city, looking north-east
In the left foreground is the main station; behind it lies the centre of the city. The bridges across the Oder are, first, the Bahnhofs bridge, followed by the railway, Hanse, and Baum bridges. In the right foreground is the Sachsenberg shipyard; behind lies Silberweise island. On the extreme right is the W. Parnitz, and behind are the basins of the Free Harbour.

the river Peene, to a junction at Ducherow with the Stralsund-Stettin line. A single-track line runs westwards along the coast of Usedom island to Wolgast, and another leads to Misdroy and Wollin by way of a train ferry across the river Swine to Ostswine.

Inland Waterways. Stettin owes much of its importance to its situation near the mouth of the Oder (see pp. 610–11), which crosses the North German Plain from Czechoslovakia through the Upper Silesian industrial area. The river is linked directly with the Berlin district by the Hohenzollern and Oder-Spree Canals, and thence to the Elbe near Magdeburg by the Elbe-Havel C. At Küstrin the Oder is joined by the Warthe, which, together with the Warthe-Netze-Bydgoscz (Bromberg) canal system, affords connexion with the Vistula. The Oder can take barges of 600–1,200 tons as far as Kosel in Upper Silesia, where the Adolf Hitler C. runs to Gleiwitz, and barges of about 200 tons can proceed to Moravska-Ostrava in Czechoslovakia.

Roads. See Fig. 17.

Kolberg

54° 11′ N., 15° 36′ E. Population: 33,735

The small port of Kolberg is situated at the mouth of the river Persante, about a third of the way along the smooth sandy Pomeranian coast between the mouth of the Oder and the Gulf of Danzig. The prevailing drift of sediment along the coast by currents from the south-west necessitates constant dredging.

Approach and Access

There is anchorage in the roadstead outside the entrance to the harbour in depths of about 7 fm., although this is very exposed. Vessels of more than 21 net registered tons (60 cubic m. net capacity) are obliged to have a pilot to enter the harbour. In heavy onshore gales it is hardly possible for ships to enter on account of the high sea and narrow channel.

The harbour is entered between two stone moles, of which the eastern extends 55 yds. farther seaward than the western. At the head of the western mole the entrance is 46 yds. wide, but it narrows inwards to 26 yds. The depth off and in the entrance to the river is maintained at 16 ft. by dredging, but in continuous stormy weather silting and reduction in depth may occur.

Only during very severe cold and onshore winds is Kolberg harbour closed in the daytime by ice, which drifts out again quickly with offshore winds.

Detailed Description

The port of Kolberg lies along the river channel between the stone moles in the entrance and the Maikuhlen bridge, a distance of some 1,200 yds. It consists of a stretch of water, where vessels up to 262 ft. in length and drawing 14½ ft. can turn; the main operating harbour (Betriebs-Hafen); and a fishing harbour with quays and landing stage on the western side of the Persante just below the Maikuhlen bridge. The quays are of timber construction; on the western bank they total 547 yds., while on the eastern side they total 328 yds.; depths alongside both are up to 16 ft. Above the Maikuhlen bridge, the river splits into two channels, but has an average depth of only 6 ft. There is a small yacht basin near the foot of the western mole.

Port Facilities

The harbour is equipped with seven storehouses, three storage sheds with a total surface area of 2,600 sq. yds., three grain storehouses with a capacity of 13,000 tons, and fish sheds with a surface area of 450 sq. yds. and with refrigerating plant. There is a small shipyard on the western bank, which can effect repairs to vessels' hulls and machinery, with a small slip capable of taking vessels up to a length of 131 ft. and a draught of 7 ft. There is a 2-ton crane on the eastern quays, and a 12-ton hand-operated floating crane is available either at Kolberg or at the neighbouring small port of Rügenwaldermünde.

Trade

The following figures summarize the trade of Kolberg for 1936 and 1937, the latest year for which statistics are available:

Trade, 1936, 1937 (*in thousand tons*)

	Coastwise		Foreign		Total
	Outward	Inward	Exports	Imports	
1936	36·3	39·9	30·5	32·0	138·7
1937	63·9	83·3	30·3	48·0	225·5

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

No detailed figures are available of the trade of Kolberg as its returns are included in those of the 'Other Pomeranian ports' traffic district. It is the third most important port, after Sassnitz and Stolpmünde, in this region. Its coastwise trade is nearly twice its foreign trade. Imports consist mainly of coal, basic slag and other fertilizers for use on the glacial soils of Pomerania, maize, timber for pulping, and stone. Exports comprise rye grain, cement, and pit-props. Foreign trade is carried on chiefly with Sweden and the Netherlands.

Industries

Kolberg, a small fishing port and holiday resort, has few industrial concerns. Apart from a small shipyard (see p. 170) there is an iron foundry and engineering works in the town. Some small concerns near the fishing harbour deal with fish-drying and preserving.

Communications

Railways. The railway station stands in a broad open space in the town centre, to the east of the river Persante. The single-track coastal line from Swinemünde to Stolpmünde crosses the Holzgraben and the Persante by two fixed bridges. A branch line runs south-east to Belgard. The quays which border the eastern bank of the mouth of the Persante have rail connexion.

Waterways. The river Persante is not navigable above the Maikuhlen bridge by vessels larger than small boats.

Roads. See Fig. 17.

STOLPMÜNDE

54° 35′ N., 16° 57′ E.

The small port of Stolpmünde is situated at the mouth of the river Stolpe, about two-thirds of the way along the smooth sandy coast between the mouth of the Oder and the Gulf of Danzig.

Approach and Access

There is anchorage for vessels in the roadstead off the mouth of the river Stolpe, in depths of about $7\frac{1}{2}$ fm. Pilotage is compulsory for vessels of over 21 net registered tons (60 cubic m. capacity). During strong on-shore gales it is hardly practicable for vessels to enter the harbour on account of the heavy breakers and the narrow

entrance to the harbour, while there is frequently a strong south-westerly current.

The approach to the inner harbour at Stolpmünde is between two nearly parallel moles, which extend in a north-north-westerly direction from the coast, enclosing an outer harbour. The western mole curves towards the other (at its head) to form an entrance between the mole heads 133 ft. wide. The outer basin is 1,345 ft. long and 377 ft. wide. Most of this basin has depths of less than 2 fm., but the shipping channel, which runs alongside the eastern mole, is dredged to 18 ft. The inner harbour is entered from the outer basin by a channel narrowed to 92 ft. by a training work.

The entrance to the Stolpe is open in winter, unless drift ice is carried on to the coast by onshore winds, but this seldom happens. The inner harbour freezes only when the sea is smooth, but unless the ice becomes very thick it is broken up by the swell sent in by onshore winds and drifts out with the current. Ice-breaking is carried out when necessary by a government ice-breaker.

Detailed Description

The inner harbour, which consists of the river channel enclosed by quay walls, extends from the inner entrance to the railway bridge above the town. There are quays on both banks of the river with a total length of 1,973 yds. A landing stage 164 yds. long projects from the southern end of the harbour parallel to the western bank, enclosing the winter harbour between itself and the eastern bank. Depths alongside the quays are 16 ft., and in the winter harbour 12 ft. Vessels with a draught of about 15½ ft. can enter the harbour, and those of a length not exceeding 243 ft. can turn there. Above the railway bridge the river is shallow and accessible only to boats.

In 1937 an iron wharf with depths alongside of 19½ ft. was under construction on the western side of the inner harbour. The harbour was being widened, concrete sea-walls built and dredging was taking place; the aim of these works was to enable vessels of 4,500 tons to use the harbour. The new construction has been completed, resulting in a small harbour on the west side of the inner harbour immediately south of the entrance. There is thus a quay 170 ft. long on the river and quayage totalling 385 ft. within the new harbour; 2,000-ton vessels have been using this new harbour.

Port Facilities

There are warehouses and sheds along the quays for accommodat-

ing bulk cargoes, and grain elevators. There is a hand-operated floating crane of 12½ tons capacity, and another of 2 tons capacity in the inner harbour. Small repairs to hulls and machinery can be carried out at a state-owned workshop.

Trade

The following figures summarize the trade of Stolpmünde for 1936 and 1937, the latest years for which statistics are available:

Trade, 1936, 1937 (*in thousands of tons*)

	Coastwise		Foreign		Total
	Outwards	Inwards	Exports	Imports	
1936	54·9	48·3	39·3	81·6	224·1
1937	37·2	56·1	34·1	107·7	235·1

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

No detailed figures are available of the trade of Stolpmünde, as its returns are included in those of the 'Other Pomeranian ports' traffic district. Its total trade is about half as much as that of Sassnitz, and slightly greater than that of its neighbour Kolberg. The chief imports are coal, coke, phosphates, stone and mineral oil, while the most important exports are rye and barley grain, cement, pit-props and sawn timber. Foreign trade is carried on chiefly with Sweden and the Netherlands.

Industries

There is a small state-owned workshop at Stolpmünde, with a slip (see above). Large castings and engine parts can be made at the *F.W. Plüntsch* foundry at Stolp, 10½ miles south-east of Stolpmünde. There is a small aircraft factory south-east of Stolpmünde at Deutsch-Buckow.

Communications

Railways. The railway station at Stolpmünde is situated south of the town near the right bank of the river Stolpe. From it lines, with sidings, run northward along the quays on either side of the Stolpe almost to the roots of the moles. Stolpmünde is the terminus of the single-track railway which wanders along the Pomeranian coast from Swinemünde. Another single-track line runs inland to Stolp along the left bank of the river Stolpe, where it makes con-

nexion with the single-track line running eastwards to Danzig and south-westwards to Neustettin.

Waterways. The Stolpe is not navigable, except for small boats, above the railway bridge at the southern end of the port.

Roads. See Fig. 17.

KÖNIGSBERG WITH PILLAU AND ELBING (Figs. 40, 41; Plates 37–40)

Königsberg 54° 42′ N., 20° 29′ E. Population: 339,000 (1938)
Pillau 54° 39′ N., 19° 55′ E. Population: 8,200 (1935)
Elbing 54° 10′ N., 19° 24′ E. Population: 80,000 (1938)

Königsberg, the capital of East Prussia, is an important industrial and commercial city, with an extensive export trade. It is approached from Pillau, its outport on the narrow entrance to the Frisches Haff, by a ship canal through the shallows at the northern end of the Haff. Pillau is a naval fortress, and is of great strategic importance in commanding the approaches to Königsberg and Elbing. The latter port is situated near the point where the river Elbing flows into the Frisches Haff, and is approached by a dredged channel.

Approach and Access

Pillau. Pillau stands at the southern end of a peninsula which projects $5\frac{1}{2}$ miles from Samland; opposite the town, across the Pillau Rinne, is the northern tip of the long Frische Nehrung, behind which is ponded the Frisches Haff. Pillau Rinne is approached from the north-westward by the Seegat, a channel about half a mile long and 328 yds. wide, dredged to a stated depth of $32\frac{3}{4}$ ft.; this depth, however, had decreased to $31\frac{1}{2}$ ft. in 1937. The actual entrance between the northern peninsula and the Nehrung is known as Seetief, and is approached between two moles, the northern being about 1,600 ft. long, the southern about 3,700 ft. Seetief extends for about 2,200 yds. in a south-easterly direction into the Frisches Haff; the dredged channel has a width of 164 to 383 yds. and is maintained at a depth of $29\frac{1}{2}$ ft. Pillau harbour extends northwards from the inner end of Seetief. Anchorage is available for vessels waiting to enter the ship canal in the outer roadstead (Pillau Road).

Königsberg. The channel of approach from Pillau to Königsberg is by the Königsberg Ship C. (Königsberger See Kanal), which is $17\frac{1}{2}$ miles long, and then through the mouth of the river Pregel.

The canal runs through the shallows bordering the northern shores

of the Frisches Haff, except where it crosses the deeper entrance to Fischhausener Wiek, a bay extending northwards. With the exception of this open water section, the canal is enclosed by embankments of sheet piling with stone filling for nearly the whole of its length. There are occasional openings in the embankments, with depths of 6½ to 8 ft., to allow fishing boats to reach the small villages on the northern shores of the Haff. The embankments on the southern side of the canal are planted with trees, bushes and reeds.

The canal, which has a minimum bottom width of 156 ft. and a depth of 26¼ ft., can normally be used by vessels drawing 23 ft.; vessels with a draught exceeding this figure must obtain permission from the traffic authorities. Vessels over 344 ft. in length or of 1,999 net tons (5,660 cubic m. net capacity) or more may only navigate the canal with the assistance of tugs, while every towed vessel with a draught greater than 13 ft. or of 529·7 net register tons (1,500 cubic m. net capacity) must have a separate tug. There are sidings where vessels can pass one another at Peyse, Gross-Heidekrug and Wehrdamm.

The channel continues up the Pregel for about 5 miles to the port of Königsberg; its depths conform to those in the ship canal.

Elbing. Elbing stands about 6 miles from the southern shores of the Frisches Haff on the right bank of the small river of the same name, which flows into the Haff a few miles east of the mouth of the river Nogat. Depths on the fairway through the Haff from the entrance at Pillau to Pfalbude near the mouth of the river Passarge are 10–16 ft. Beyond this point, a channel dredged to 13 ft. and marked by buoys runs west-south-west, and from this the Elbinger Fahrwasser, a dredged channel about 164 ft. wide with a depth of 13 ft., partly enclosed by moles, leads to the river Elbing. The channel in the river, which is 148 ft. wide, also has a depth of 13 ft., and is available for vessels with a draught of 11½ ft. Water level in the river, however, is dependent on the wind, and may rise or fall as much as 3¼ ft. with northerly or southerly winds respectively.

Pilotage is compulsory for all vessels entering the Seetief, and proceeding to Pillau, Königsberg or Elbing, except those under 17,658 cubic ft. (500 cubic m. net capacity) and those specially exempted.

Navigation to and between Pillau, Königsberg and Elbing is likely to be hampered by ice from January to March, occasionally as early as December. The Pillau Seetief seldom freezes over owing to the strong current. Frisches Haff, however, usually freezes for con-

siderable periods, and, in fact, traffic of persons and vehicles takes place over the ice. The ice in Pillau harbour and in the canal is broken up daily by an ice-breaker, and can be approached as long as fixed ice does not form in the Baltic. When the upper waters of the Vistula flow through the mouths of the Nogat into Frisches Haff, the ice breaks up, and heavy drift ice floats out through the Seetief. Great caution is then required when entering.

Detailed Description

Pillau. The harbour consists of a series of basins extending northwards from the inner end of Seetief. A curving mole (the Südliche Abschlussdamm), not connected with the shore, bounds the Vor-Hafen on the south, which has a depth in the middle of 127 ft. There is an entrance 400 yds. wide, with a depth of 28 ft., between the curving mole and a shorter one projecting from the peninsula on which the town of Pillau stands. To the south of the curving mole is another mole, the stretch of water between the two being known as Petroleum-Hafen, with depths of 10 to 23 ft. The Vor-Hafen is connected at its south-eastern end with the Ship C., by a channel across the Petroleum-Hafen with a least depth of 30 ft. Vessels over 2,825 net register tons (8,000 cubic m. capacity) or over 394 ft. in length are not permitted to lie alongside the wharves in the Vor-Hafen.

The Innen-Hafen and Hinter-Hafen extend north-north-eastward between the town of Pillau and Russischer Damm. A small basin, the Graben, extends about 328 yds. west-north-westwards from near the southern end of Innen-Hafen, and has depths of 19 ft. over the greater part. On the eastern side of Russischer Damm are the Bau-Hafen and the Holz-Hafen, separated by a railway bridge; a dog-legged mole extends westwards across the southern end of the Bau-Hafen, leaving a narrow opening into the Vor-Hafen to the south. On the western side of the Innen-Hafen is the Town Quay, 1,542 ft. in length, available for vessels drawing 21 ft., while on the western side is the maritime station. The western side of the Hinter-Hafen is bordered by the Railway Quay, with 5,741 ft. of quayage available for vessels drawing 21 ft. On the north-eastern side of the Hinter-Hafen is a recently constructed U-boat harbour, comprising a basin containing a pier with U-boat pens, with pens also on the north side, and a small slip. North of the U-boat basin is a small fishing harbour, with depths of 10 ft. Subsequently to 1939 the area to the south-east of the Hinter-Hafen has been dredged to form a new harbour

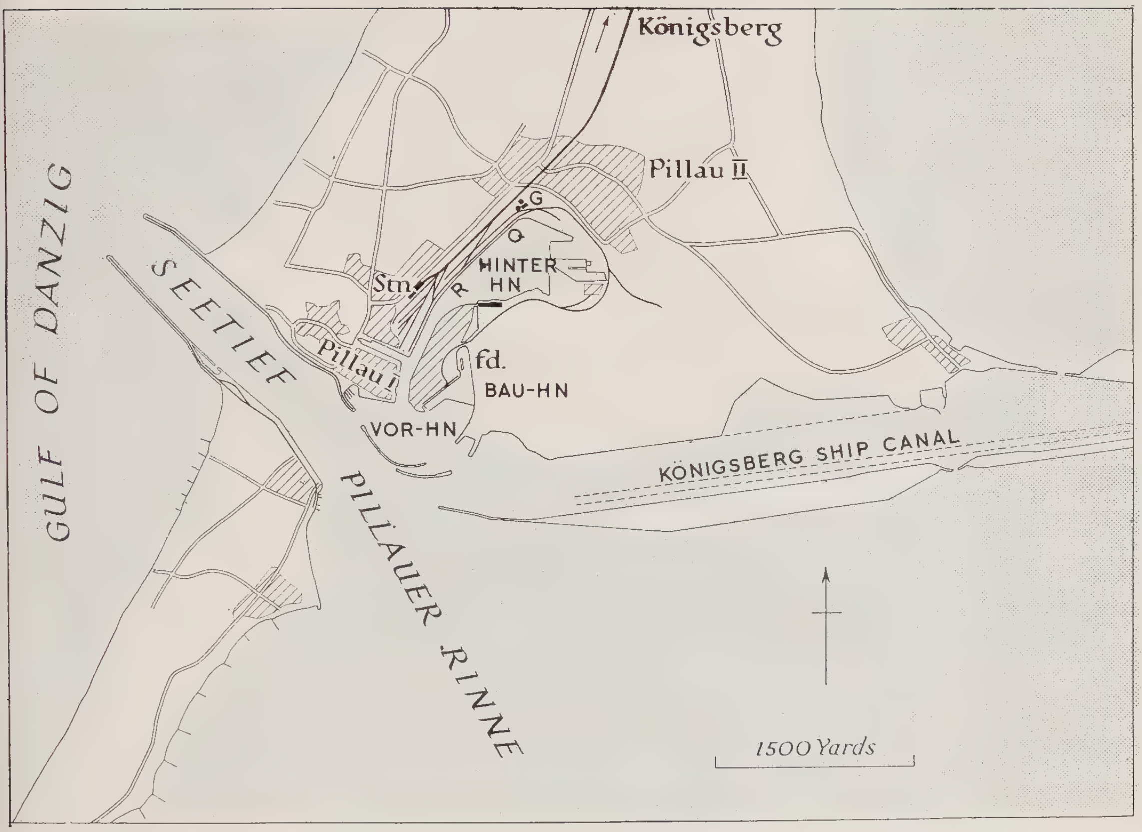

Fig. 40. Pillau

Based on official sources.

fd. Floating dock; G Gasworks; RQ Railway quay.

Fig. 41. Königsberg

Based on official sources.

fd Floating dock; G Gasworks; P Power station. A locomotive works lies to the east of the railway works. Most of the buildings shown along the Alter-Pregel are sawmills.

of two basins, separated by a concrete jetty. In the northern basin there are two quays, 1,500 ft. and 1,760 ft. in length; in the southern basin there are also two quays, 3,500 ft. and 1,500 in length. A third basin lies to the south of these. Other new construction work has taken place along the shore to the west of Kamstigall peninsula.

Königsberg. The port of Königsberg lies on either side of the river Pregel, some 5 miles upstream from the Frisches Haff. The two arms of the river, the Alter- and Neuer-Pregel, unite within the town, the main port lying below the junction. The outer harbour, below the new railway and road bridge, has depths of 22–26 ft., the Alter Pregel as far as the Hohe Brücke has depths of 20 ft., and beyond this to the river craft basin, known as the Georgs Kanal, of 15 ft., while the Neuer-Pregel has depths of 16–20 ft. The two branches of the river are used mainly by river craft, chiefly owing to the narrowness of the channel.

The old harbour (Alter-Hafen) comprises the Pregel channel east of the new railway and road bridge. There is about 7,000 ft. of quays, with depths of 21 ft. alongside.

The new harbour consists of the river channel (Unter-Pregel) west of the new railway and road bridge, with three large basins on the south bank. The total quayage is about 13,000 ft. Numerous short jetties and landing-stages project into the channel from the northern bank. Basin III (Frei-Hafen) is 2,000 ft. long, Basin IV (Industrie-Hafen) is 4,000 ft. long, and Basin V (Holz-Hafen) is 3,478 ft. long; all three have depths of 26¼ ft. Basins I and II are projected: they will be excavated on the site of the present Railway Quay and Quay station.

The Unter-Pregel is crossed by the new railway and road bridge, which has two openings, 57 ft. and 58 ft. in width. The Alter-Pregel is crossed below the junction with the Neuer-Pregel by the old railway swing bridge with an opening of 38 ft., and above the junction by four iron hydraulic lift bridges with openings of 40–41 ft. The Neuer-Pregel is crossed by three iron hydraulic lifting bridges, two with openings of 74 ft. and one of 52 ft. The short channel connecting the two rivers above their junction is crossed by the Honig Brücke, with an opening 33 ft. wide.

Elbing. At Elbing, the river is divided into two channels by Speicher island, with the Stadtgraben to the west and the main river to the east. The harbour consists of the easterly branch of the river, between the island and the town, which at this point is about 50 yds. wide, with depths of 13 ft. Both banks are bordered by

sea walls, with depths alongside of 8–13 ft. On the eastern side to the north of the town is the Industrie-und Handelshafen, which has a depth of 13 ft. Two small basins are used by fishing boats. The harbour is crossed by two lift bridges, about 200 yds. apart, with openings of 38 and 44 ft.

Port Facilities

Pillau. No details are available of storage accommodation at Pillau, but this is not extensive as it is not an important commercial port. The Harbour Authority's Shipyard in the Bau-Hafen is a small repairing yard. The *Schichau* company also has a small yard on the south side of the Hinter-Hafen where all ordinary repairs to small vessels can be undertaken. Lifting appliances comprise a 20-ton crane on the Railway Quay in the Hinter-Hafen; it is reported that the recently constructed basins to the south-east of the Hinter-Hafen have a total of eight cranes, capacity unknown. A 60-ton floating crane is also reported in the Bau-Hafen.

There were two floating docks in the port in 1944: one dock was 235 ft. long and 53 ft. wide, and the other had three sections 70 ft., 68 ft., and 80 ft. long and 43 ft., 52 ft., and 43 ft. wide respectively.

Königsberg. The town is the centre of the east European trade in several bulk commodities (see p. 186), and there is therefore extensive storage accommodation. On the southern bank of the old harbour are several storehouses, including the two-storey *Werfthalle*, belonging to the *Königsberger Hafengesellschaft.* On the northern bank are a number of old warehouses, some private, some owned by the town, including the *Heringsbrake* (the centre of the herring trade), the *Körnerspeicher* (grain warehouse) and the *Packhof*, belonging to the customs authorities. On the southern bank of the new harbour, immediately west of the new road and railway bridge, are the extensive sheds of the quay railway station, occupying about 24,000 sq. yds. of storage space. Basin III has two large storage buildings. Near the northern entrance to Basin IV are the large buildings of the *Gruppen-und Turmspeicher*, a modern grain storehouse with a capacity of 40,000 tons, and other warehouses along the northern quays. Basin V has extensive timber stacking places. Along the northern shores of the outer harbour are numerous industrial concerns, including the Königsberg cold-storage plant, the town gasworks with coal-handling installations, the *Königsberg Lagerhaus*, which has a capacity of 50,000 tons and is the largest granary in Europe, a large oil storage depot, and many smaller warehouses.

Below the outer port on the left bank is the shipyard of *F. Schichau G.m.b.H* (*Elbing*) which had three floating docks, 410 ft., 295 ft., and 167 ft. in length, and with lifting capacities of 3,500, 2,400 and 400 tons respectively. There is also a patent slip 150 ft. long with a lifting capacity of 650 tons, a large foundry and well-equipped workshops capable of large repairs. A smaller yard is that of *Otto Kuczewski*, which has two longitudinal slips to take vessels 145 ft. and 130 ft. and a broadside slip to take vessels 145 ft. long.

By the end of 1944 the floating dock position had changed considerably, and the following docks were present in the port (dimensions in ft.):

	Length	Breadth	
Schichau Yard . .	300	72	
	300	72	
	296	68	
	187	32	
Naval Docks . .	500	80	
	290	48	daughter dock
	316	60	
	223	63	mother dock
	223	48	daughter dock
	223	48	,, ,,
	290	48	,, ,,

The reported total of cranes at the port of Königsberg is forty-two. This number includes seven electric half-portal cranes of 2–6 tons capacity, and one stationary electric crane of 25 tons in the inner harbour; six electric 3-ton portal cranes to unload ships directly into railway trucks, and two electric 5-ton half-portal jib cranes on the quays in Basin III; and eight electric 3-ton portal cranes, six electric 5-ton portal jib cranes, one landing stage with one 5-ton jib crane, and several floating cranes up to 15 tons in Basin IV. The *Schichau* shipyard has one 25-ton sheer-leg crane and three cranes of 3–5 tons capacity on the fitting-out quay. Storage equipment at Elbing comprises two sheds with available floor-space of 30,000 sq. yd., two modern grain silos with a total capacity of 43,000 tons, and extensive open stacking space.

Elbing. The main yard of the *F. Schichau G.m.b.H.* concern is at Elbing, and builds destroyers, torpedo boats, merchant ships up to 4,000 tons, coastal and river craft. It has a floating dock * composed of two docks coupled together with a length of 158 ft., capable of lifting a destroyer; seven slips, the largest being about 370 ft. in length; extensive foundries and engine shops, a new welding shop, and considerable fitting-out quayage. Belonging to the same firm

* Early in 1945 there was one floating dock, 330 ft. long and 42 ft. wide.

is a locomotive and marine boiler works, situated to the east of the yard. The small yard of *A. Zedler* has a slip to take vessels 115 ft. long.

The harbour has one crane to lift 300 tons, another to lift 80 tons, and several smaller ones, including two portal grab cranes each of 5 tons capacity, a grab crane of 3 tons capacity, and two piece-goods cranes, each of 3 tons capacity.

The City

Königsberg is the capital and largest city of the isolated Prussian Province of East Prussia which is cut off by Polish territory from the main part of the Reich. The town developed at the lowest point of the Pregel where the river could be conveniently crossed before reaching the Frisches Haff some 5 miles away. Kneiphof island facilitated the crossing and a hill (the Haberberg) protected it. The main part of Königsberg lies from 5 to 15 m. above mean sea level on the northern slopes of the 2-mile broad Pregel valley. It has been built in and around the valley of a stream which ran into the Pregel from the north. Since the establishment of the town the waters of the stream have been dammed up into two lakes—the *Oberteich* on the northern edge of Königsberg and the *Schlossteich* inside the town.

The first urban settlement (the *Altstadt*) developed in the second half of the thirteenth century around the castle lying at the southern end of the *Schlossteich*. It was gradually extended to the Alter Pregel. Here it joined another settlement on the Kneiphof, an island in the Pregel at the junction of the Alter Pregel and the Neuer Pregel. A third settlement (Löbenicht) sprang up, about 1300, towards the north of the Alter Pregel just to the east of the *Altstadt*. Until about 1600 the *Altstadt*, the Kneiphof and Löbenicht were separate little towns, each surrounded by its own walls.

The urban area was considerably extended between 1626 and 1634 since—because of the landing of Swedish troops at the adjacent outport of Pillau—it was necessary to build new fortifications. The walls now ran round Tregheim and Sackheim to the north of the Alter Pregel (i.e. they included the whole of the *Schlossteich*) and they reached the Haberberg to the south of the Neuer Pregel. In 1724 the three Königsbergs were united into a single administrative unit. Gradually the open spaces between the three original urban settlements and the new seventeenth-century walls were built up. When new fortifications were constructed between 1843 and 1859 it was possible to follow the course of the seventeenth-century walls with few modifications. These fortifications were removed in 1910.

In the latter years of the nineteenth century urban expansion took place beyond the city walls to the north (in the district known as the Samland). At the same time the docks (the Industriehafen and the Handelshafen) developed on the left bank of the Pregel below Königsberg. The Königsberg Sea C. joining the lower Pregel with Pillau on the Baltic was completed in 1901.

To-day, the centre of Königsberg is the main business quarter. Most of the Government offices are in the Tragheim district. The suburbs of Sackheim and Kosse are working-class settlements; Mittelhufen and Vorderhufen are middle-class residential quarters, while Amalienau and Maraunenhof are upper-class residential districts.

Königsberg is an administrative centre in the Reich and in Prussia. Offices of the Reich include those for finance (three *Finanzämter*), customs (two *Hauptzollämter*), labour (*Arbeitsamt*), the state railways (*Reichsbahndirektion*), the state post office (*Oberpostdirektion*) and the army (*Wehrkreiskommando*). In Prussia the city is the capital of three districts—the Province of East Prussia, the *Regierungsbezirk* Königsberg, and the rural district of Königsberg. The Prussian province of East Prussia was reduced in size after the war of 1914–1918 by the loss of the Memel territory. It now has an area of 14,240 sq. miles (excluding the Kurisches Haff and the Frisches Haff) and a population of 2,333,300. The *Regierungsbezirk* Königsberg has an area of 5,760 sq. miles and a population (in 1925) of 911,880. The rural district of Königsberg has an area of 394 sq. miles and a population of 50,990 (1925). Königsberg has a University, a Commercial College and an Art Academy. It has several museums (e.g. the *Prussiamuseum* of pre-history) and learned societies (e.g. the *Kgl. Deutsche Gesellschaft* dating from 1743).

The most notable buildings in Königsberg include the following churches: the *Juditter Kirche* (c. 1200), the Gothic Cathedral (1297–1302), the thirteenth-century *Steindammer* (formerly *Polnische*) *Kirche*, the *Neurossgärter Kirche* (1467), the seventeenth-century *Altrossgärter Kirche*, the eighteenth-century *Harberger Kirche*, the Catholic Church (1614–16). Among secular buildings the following deserve mention: the Castle (1584–94; extended 1705–12), the fourteenth-century Town Hall of Kneiphof, the University (1844–62), the Bourse (1875), the Government Buildings (1872–8) and the City Theatre (1866).

Pillau. The small outport of Pillau has a customs office, a pilot office, a harbour master's office and a military garrison. Its

importance lies almost solely in the fact that it is a port of call for steamers on routes to Königsberg, Zoppot, Swinemünde, Elbing and Memel.

History

Königsberg castle was built in 1255 by the Teutonic Knights and was named after Ottokar II of Bohemia, who had led a crusade in the district. Under the protection of the castle three small townships developed—the *Altstadt*, Löbenicht and Kneiphof—which gained municipal rights in 1286, 1300 and 1327, respectively. In these adjacent market towns a lively commerce developed both by land and sea. The power of the Teutonic Knights was broken by the Poles and Lithuanians at the Battle of Tannenberg in 1410. Shortly afterwards (1457) the great fortress of Marienburg was lost to the Poles and Königsberg then became the seat of the administration of the Grand Masters of the Teutonic Knights. In 1466 Prussia was partitioned. West Prussia and Ermland fell to Poland while East Prussia—isolated until the eighteenth century from other German lands—retained a measure of independence but was a Polish fief.

In 1523 in Königsberg Cathedral the Bishop of Samland told his congregation of his delight 'that Our Lord has for a second time been born upon earth'. 'He was'—writes Treitschke—'the first prince of the Catholic Church to accept Protestantism'. A few years later the last Grand Master of the Teutonic Knights (Albert of Ansbach, a member of the Hohenzollern family) accepted the Reformation and he was granted East Prussia as a temporal hereditary Duchy. Königsberg remained the seat of the Duchy's administration. The Albertus University was founded in 1544. After a period of decline in the seventeenth century the university gained fame since Kant taught there.

Early in the seventeenth century the branch of the Hohenzollern family which had been ruling in East Prussia died out and the Hohenzollern Elector of Brandenburg became ruler of East Prussia. The Duchy was still a Polish fief, and remained so until the Great Elector of Brandenburg freed it from Polish suzerainty in 1660. Frederick III of Brandenburg took the title of King in Prussia and crowned himself at Königsberg in 1701. During the reign of Frederick the Great Königsberg was occupied by the Russians in 1759–62 at the time of the Seven Years War. Frederick's acquisition of Polish territory linked the Duchy of Prussia once more with the remaining eastern districts of the Kingdom. After the Battle of

Friedland in 1807 Königsberg was occupied by French troops. The East Prussian Diet which met at Königsberg in 1813 played an important part in raising forces locally for the overthrow of Napoleon.

Whereas in the sixteenth century Königsberg had had a modest mercantile marine and her harbour was the scene of some commercial activity there was a considerable decline in the seventeenth and eighteenth centuries owing largely to Dutch competition. By 1675 Königsberg had only 23 ships, and by 1704 trade by sea was entirely in the hands of vessels from other ports. At the end of the Napoleonic Wars, too, Königsberg's commerce was in a depressed state. In February 1817 it was reported that trade with the hinterland was virtually at a standstill and that commerce by sea was 'also quite insignificant'. Recovery was slow, partly because of the very restrictive commercial policies of Great Britain and Russia. Great Britain's high import duties on timber and grain greatly hampered the export trade of Königsberg in those products. On the other hand, Russia's prohibitive tariffs made it extremely difficult for Königsberg merchants to import British manufactured articles with a view to re-exporting them to Russia. British trade restrictions were, however, gradually relaxed, and in the forties the policy of Free Trade was adopted. This was of considerable benefit to the port. In those days its commercial contacts with Great Britain were closer than those with western Germany. Owing to the poor communications of Prussia's eastern provinces it was to a great extent isolated from other parts of Germany, and the trade of Königsberg was largely carried on by sea routes.

In the middle of the nineteenth century Königsberg sent to Great Britain grain (wheat, rye, barley, oats); peas and beans; flax and hemp; salted beef and pork; and also linseed and oil cakes. Imports from Great Britain included coal, sugar, salt and various manufactured articles such as metal and textile goods. Königsberg thus had a considerable transit trade and the port was a link between the chief manufacturing state in the world and the vast agricultural regions of eastern Europe. During the Crimean War Königsberg's exports to Great Britain increased, since Prussia was a neutral country, and even some Russian products found their way to Great Britain by way of Prussia's Baltic ports.

Gradually the economic and political unification of the Reich brought Königsberg into closer touch with other parts of Germany. Owing to the energy of von der Heydt (the Prussian Minister of Commerce) the important Eastern Railway (*Ostbahn*) from Berlin

reached Königsberg by way of Frankfurt-an-der-Oder and Danzig in 1853. There was, however, a gap between Dirschau and Marienburg where two great bridges over the Vistula and Nogat rivers had to be built. This work was completed in 1857. Then in 1860–1 the *Ostbahn* was extended from Königsberg to Eydtkuhnen and so the port was linked with the Russian railway system. The agricultural hinterland of Königsberg, however, was not well supplied with railways. In 1910 the Reich as a whole had 109·1 km. of railways per 1,000 sq. km., while East Prussia had only 75·2 km. Nevertheless, Königsberg had become a 'railway port' at the end of the nineteenth century. In 1895–6, for example, only 13·1% (by weight) of the imports of Königsberg-Pillau were forwarded to the hinterland by inland waterways and only 26·7% (by weight) of the goods exported had reached the harbours of Königsberg-Pillau by river or canal.

After the unification of the Reich in 1871 Königsberg began to fulfil the same function for the manufacturing districts of Germany as she had once fulfilled for those of Britain, exchanging German manufactured goods for east European farm and timber products. The commerce of the port before the war of 1914–1918 largely depended upon its vast Russian hinterland. The Russo-German Commercial Treaties of 1894 and 1904 provided that there should be no tariff discrimination against the port of Königsberg in favour of Russia's Baltic ports. Moreover, Königsberg had some advantage over other German Baltic Ports in the matter of railway freight charges. 'Hence'—as Ian F. D. Morrow observes—'Königsberg was largely a Russian seaport before the World War, and one that possessed the very important advantage in Russian eyes of being free from ice throughout the year.'

Industries developed considerably in the last quarter of the nineteenth century and in the early years of the twentieth century. The most important were those connected with timber, metals and milling. Locomotives, ships and farming machinery were constructed. Industrial growth, however, was slow in comparison with that of other great German cities (*Grosstädte*). In 1895, for example, more than half of the working population living in big cities in the Reich were engaged in industrial work or in mining. In Königsberg, however, barely 36% of the working population was engaged in industry. The total population increased as follows:

1838	68,000	1900	187,897	1932	296,000
1871	112,000	1925	286,660	1938	336,100

After the war of 1914–1918 East Prussia was cut off from the main

Plate 37. Elbing: *F. Schichau* shipyard

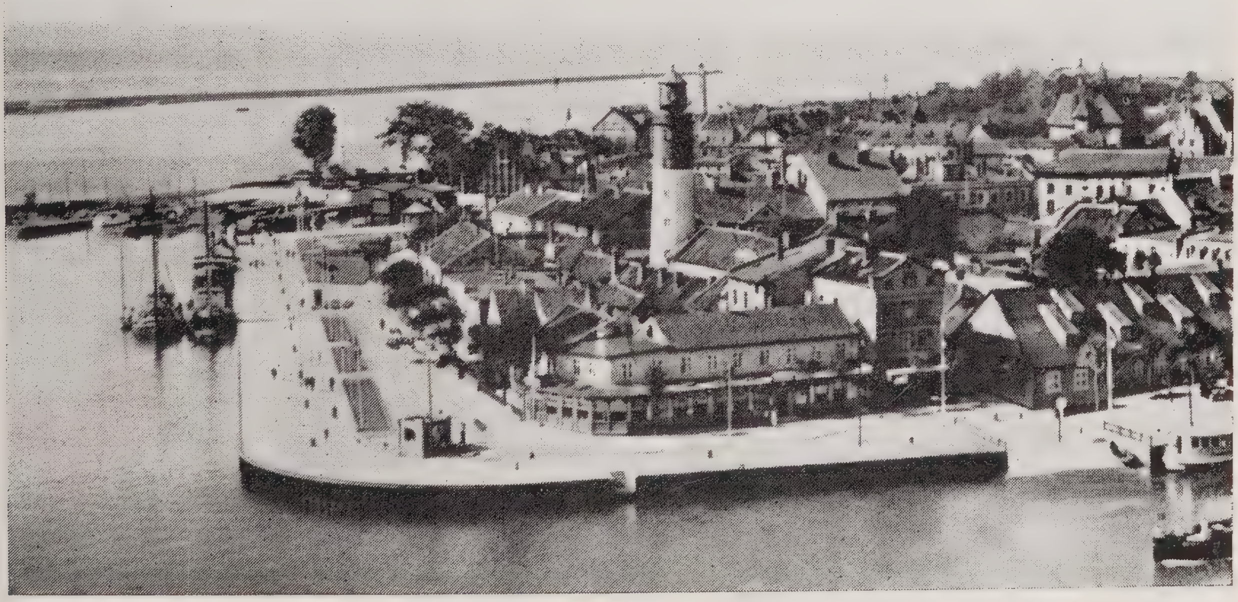

Plate 38. Pillau, looking west

The view shows the compact settlement of Pillau I. In the foreground is the Vorhafen. Behind the buildings can be seen the Seetief, or entrance channel, and the south mole.

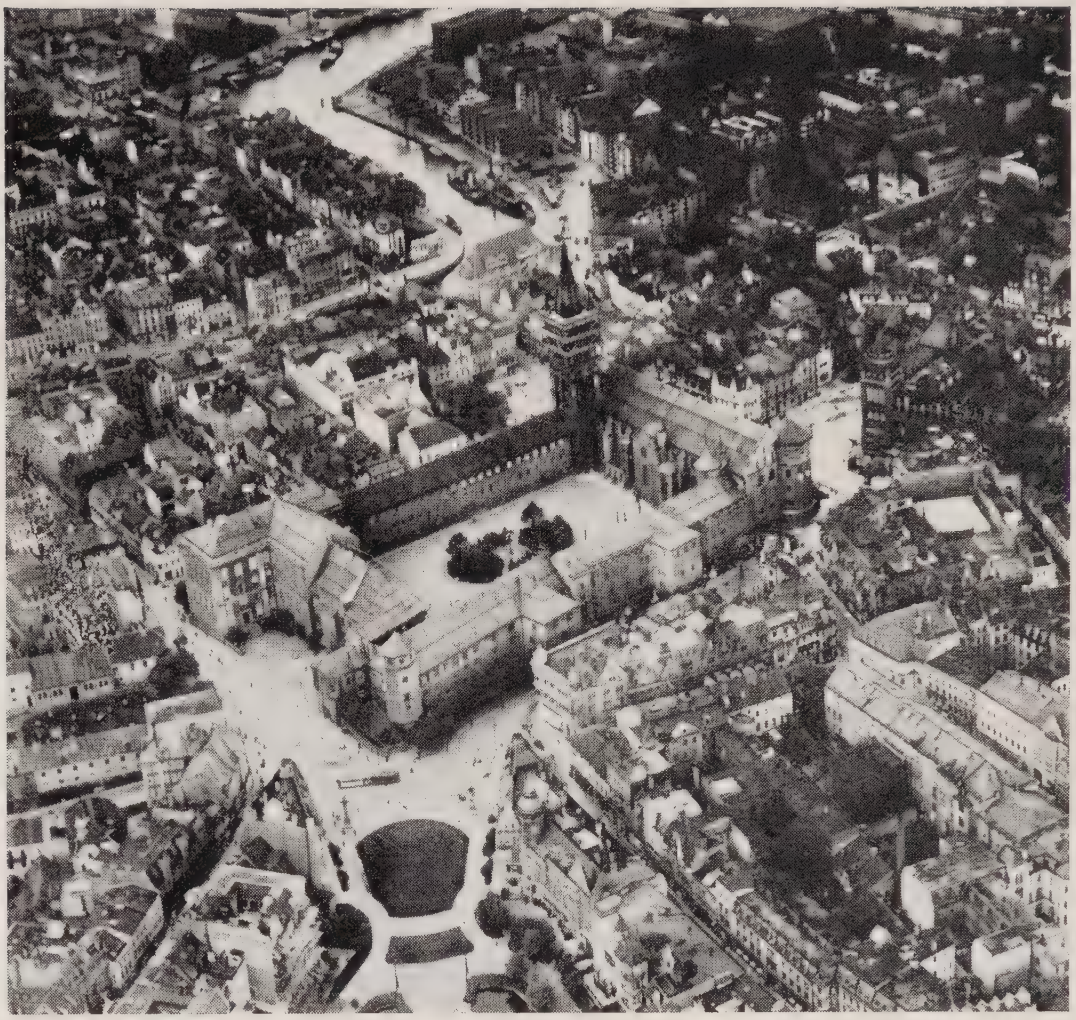

Plate 39. Königsberg: the heart of the city, looking south-west
In the centre is the Schloss, while in the background can be seen the Neuer Pregel.

Plate 40. Königsberg: the silos, looking west
This granary has a storage capacity of 50,000 tons.

part of the Reich by Polish territory—as she had been in the eighteenth century. This fact—coupled with the hostility of Poland and Soviet Russia—hampered the trade of the port. The Eastern Fair was established in 1920 in an effort to recapture for Königsberg its old position of a commercial intermediary between the agricultural districts of eastern Europe and the manufacturing districts of western Europe.

Königsberg's trade balance worsened in the years that followed the war of 1914–1918. Whereas before 1914 imports and exports generally balanced each other, the position in 1929 was that imports amounted to nearly 1,100,000 tons and exports amounted to only a little over 600,000 tons. 'This'—writes Dr. von Mühlensfels—'implies a diminution in outward bound cargoes and a consequent increase in freight rates for Königsberg's sea-borne trade'; '. . . a considerable diminution of traffic, especially in cereals, leguminous crops, and flour, in timber and manufactured wooden articles, in fertilizers, etc. On the other hand, there has been an increase in the traffic in minerals and especially coal. This increase—and the fact that it is now necessary to bring wood for the East Prussian sawmills and cellulose factories by sea instead of by the inland waterways—have caused the figures for Königsberg's maritime imports to be larger in 1928 than in pre-war times, while Königsberg's commerce is below the pre-war standard. The fact that exports through the port of Königsberg are some 200,000 tons below those of pre-war days is almost entirely due to the absence of Russian trade (cereals and leguminous crops). . . . Königsberg's total turnover in imports has decreased by about 700,000 tons compared with 1913 and by about 350,000 tons in exports. That is to say, the total average turnover has decreased by approximately one-fifth.'

Thus the fact that after 1919 Königsberg was cut off from direct communication by land with Russia had serious consequences for the port. Before 1914 Königsberg had sent to Russia large quantities of herrings (about 400,000 barrels a year), coal, manures and groceries. And three-quarters of the goods leaving Königsberg had originally come from Russia. Timber, grain and leguminous crops had been exported from Russia by way of Königsberg. Before 1914 Königsberg 'was able more or less to balance the excess of imports over exports in its East Prussian trade by a corresponding excess of exports over imports in its Russian trade' (Ian F. D. Morrow). The new frontiers of 1919 broke up the network of railways which served Königsberg and the highly protectionist policy of Soviet

Russia greatly restricted trade. Königsberg lost much of its former commerce with Russia: the trade in herrings came to an end, and exports of Russian grain and leguminous crops sank to insignificant proportions of their former volume. Exports of Russian timber—already declining between 1911 and 1913—sank still further. This was partly due to the diversion of the export timber trade from Königsberg to Danzig.

Trade

The following figures summarize the trade of Königsberg, Pillau and Elbing for 1936 and 1937, the latest years for which statistics are available:

Trade of Königsberg, Pillau and Elbing, 1936, 1937
(*in thousand tons*)

	Coastwise		Foreign		Total
	Outwards	Inwards	Exports	Imports	
Königsberg:					
1936	543·5	2,539·6	233·8	1,268·4	4,585·3
1937	656·4	1,254·9	219·4	1,558·4	3,689·1
Pillau:					
1936	—	29·4	0·0	0·8	30·2
1937	0·1	31·2	—	1·6	32·9
Elbing:	48·8	296·5	—	16·0	363·3
1936	40·7	191·6	0·8	34·1	267·2
1937					

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, p. 4.

Detailed figures are not available for each of these ports, but are given for the traffic district of the 'East Prussian ports' as a whole. However, as the total tonnage handled at Königsberg in 1937 amounted to 3·7 million tons out of a total of 4·0 million tons for all East Prussian ports, it is clear that a discussion of the East Prussian figures as a whole will afford a fair indication of the trade of Königsberg; the balance is mainly accounted for by that of Elbing. It is of interest that the imports (3·1 million tons) into the East Prussian ports were more than three times as great as the exports (0·9 million tons), and that the total of the coastwise trade (2·1 million tons) considerably exceeded that of the foreign trade (1·7 million tons).

Imports. The following table summarizes the imports of the East Prussian ports in 1937:

	Tons		Tons
Coal	975,847	Coke	97,634
Timber for pulping	377,398	Maize	93,037
Cement	298,138	Pyrites	83,019
Stone	187,793	Oilcake	76,017
Basic slag	155,113	Artificial stone	68,363
Mineral oil	127,497	Logs	52,879

From: *Die Seeschiffahrt im Jahre 1937*, Heft I, pp. 8–17.

The outstanding customer was the Netherlands, which took 227,000 tons of the total foreign exports of 254,000. Coastwise trade to other parts of the Reich (mainly consisting of grain and flour) amounted to 660,000 tons.

The trade of Königsberg suffered greatly from the boundary changes consequent upon the Treaty of Versailles in 1919. It is largely a port built to serve a hinterland which no longer exists (see p. 185).

Industries

Königsberg. The largest shipyard in Königsberg is that of *F. Schichau G.m.b.H.*, a branch of the Elbing concern (see p. 179), building river craft and auxiliary naval vessels up to 1,300 tons. The yard includes a large iron foundry. There is also a small yard of *Otto Kuczewski* (see p. 179). A small factory constructs marine boilers. On the north bank of the Pregel below the town is the *Waggonfabrik L. Steinfurt A.G.*, which in 1939 had a capacity of 2,000 standard 20-ton trucks per annum.

The port handles a considerable amount of timber (see p. 185), and there are a number of industrial concerns using timber, including several large saw-mills, which are mainly situated in the Mühlenhof suburb along the south bank of the Alter-Pregel, joinery and furniture works, a wood-impregnating plant, and cellulose factories. The two largest cellulose factories are those of the *K.B.G. Zellstoff Fabrik Koholyt*, situated to the west of the city on the north bank of the Unter-Pregel and to the east of the city on the north bank of the Neuer-Pregel, respectively. There is also a sulphite pulp plant.

There is a large flour mill on the north bank of the Unter-Pregel, which has a capacity of 100 tons per day. Miscellaneous industries include a tyre-retreading plant, a large brewery, an oxygen-producing plant, and an ethyl alcohol distillery.

Pillau. There are two small repairing shipyards at Pillau, the

Harbour Authority's yard and a small one owned by the *Schichau* company (see p. 178).

Elbing. The chief industrial concern is that of *F. Schichau, G.m.b.H., Elbing* (see p. 179), the main yard of the company being situated at this port. It builds 1,200-ton destroyers, torpedo boats, merchant ships up to 4,000 tons, and small coastal and river craft. The Schichau concern also owned a large locomotive and marine boiler works. Other industrial concerns include the Englisch-Brunnen brewery, a brick works, a tobacco factory, an automobile factory, a large joinery, a pencil factory, and a factory making roofing felt.

Communications

Railways. The main passenger station at Königsberg is situated about 1,000 yds. south of the Pregel, and thus lies some distance from the city centre. The city and its suburbs are served by several railway stations, including the Hollanderbaum on the north bank of the Pregel, and the Pregel, Ratshof, Nord and Maraunenhof stations on the west and north of the city. There are three goods stations; the main one, which has a marshalling yard with a handling capacity of 2,200 trucks per twenty-four hours, is situated to the north of the main passenger station; the Quay goods station is behind the Railway Quay on the south bank of the Unter-Pregel; and the Nord goods station lies west of the Ober Teich in the northern outskirts of the city. The quays along the southern bank of the river, as far upstream as the junction of the Neuer- and Alter-Pregel channels, have rail connexions, and the three large basins have extensive sidings. The north bank of the river is less adequately served. There are sidings along the Town Quay between the new and old railway bridges, and the industrial concerns west of the city have their own sidings. The quays and industrial concerns along the Neuer- and Alter-Pregel channels have no rail connexions.

Königsberg is a railway centre of some importance. A main double-track line runs south-westward through Elbing and Marienburg, then across the Polish Corridor and on to Berlin. Other double-track lines run eastward to Insterburg and Vilna, and south-eastwards to Lyck and on into Poland. Single-track lines link Königsberg with Fischhausen and Pillau to the west, with Cranz, Neukuhren and the Samland coast to the north, and with Tilsit to the north-east. The narrow-gauge railway terminus is the Possindern Tapiau station, north of the new railway bridge; the light railway

runs in an arc around the north of the city to the Königstor station, then continues north-eastward to Neuhausen.

The railway station at Pillau is situated west of the entrance to the Hinter-Hafen, with the neighbouring maritime station on the quays of the Innen-Hafen. A loop line runs along the Railway Quay and round the Hinter-Hafen, crossing the bridge between the Holz- and Bau-Häfen, and ending in the Harbour Authority's shipyard. Lines run along either side of the Seetief and out to the ends of the moles, but are not connected with the main railway system. The single-track line to Fischhausen and Königsberg leaves Pillau through the north-eastern suburbs.

The main station at Elbing lies to the south of the town, and is adjoined by a small goods station. A branch line runs north through Haffufer station, serving the quays of the Industrie und Handelshafen. The main double-track line from Königsberg to Marienburg passes through Elbing. A narrow-gauge line runs north along the east bank of the Elbing river to the shore of the Frisches Haff, which it follows north-eastward via Tolkemit and Frauenburg to Braunsberg.

Inland Waterways. The Pregel above Königsberg is navigable by small craft as far as Tapiau, and by small boats as far as Insterburg. At Tapiau a short cut has been made into the Deime, a small river flowing into the Kurisches Haff. This channel, which has a minimum depth of 4 ft., is often used by small coasters in ballast which are going to Memel for cargoes. An alternative route has been made between Königsberg, Tilsit and Memel by linking with short canals various sections of the rivers flowing into the Kurisches Haff. From Tapiau near the mouth of the Deime river, small craft can proceed by the Grosse Friedrichs and Seckenburger canals into the Nemonien (Gilge) and so to Tilsit. From this town, vessels can proceed down the Russ, up the river Minge, and along the König Wilhelm C. to the Kurisches Haff south of Memel. According to an official German statement of 1940, the completion of the Masurian C. in East Prussia was then imminent. The scheme envisaged a canal from the Pregel to the Masurian Lakes, thence the route would follow the rivers Pissa and Narew, thus forming a direct water link between Königsberg and Warsaw.

Above Elbing, the river Elbing is navigable by small vessels into the Drausen See, and thence along the Oberländischer C. and Deutsch-Eylau.

Roads. See Fig. 17.

War Time Conditions, 1939–44

The German ports have undergone, in many cases, striking changes since the outbreak of war in 1939. In the sphere of trade the long-distance overseas trade has practically vanished. Short-sea and coastwise trade has been subject to changes of routing according to the operation of factors like the safety of a given sea passage or the state of inland communications like the Dortmund-Ems Canal. The import of Swedish iron ore has been the dominant traffic through the ports. Owing to the eventual failure of early German plans to continue the use of Rotterdam for bulk imports of iron ore, efforts were made over a considerable period to develop the bulk-handling facilities of Hamburg.

The port works have suffered a good deal from air attack, but by no means all have been put out of working order. Warehouses have been destroyed, cranes wrecked and power supplies interfered with to an extent which has varied considerably from port to port, and which has not been very marked east of Kiel. A number of the floating docks have been sunk. To some extent cranes and other hoisting gear have been transferred from one port to another at different times.

The industries, public utilities and buildings have suffered very great damage in many cases. Owing to the extensive rebuilding which will be necessary in many instances, some German ports and towns are likely to benefit greatly from re-planning.

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Chapter III

RAILWAYS

General Features: Introduction; Historical Background; Ownership; Classification of the Network; Administration; The Permanent Way; Engineering Works; Locomotives; Other Rolling Stock; Electrification; Diesel-electric and Diesel Operation; Train Control; Train Speeds; Passenger Trains; Goods Trains; Mountain Lines; Train Ferry Services; Goods Traffic; Railway Freight Rates.

Geographical Description: North-West Germany; Lower and Middle Rhineland and West-Central Germany; The Ruhr; Upper Rhineland; South Germany; Central Germany; North-East Germany; South-East Germany; Berlin; War-time Conditions, 1939–44; Tables

Bibliographical Note

GENERAL FEATURES

Introduction

Germany possesses the most important single railway administration in the world. At the end of 1937 (i.e. before the incorporation of the Austrian Federal Railways into the Reichsbahn), 33,878 miles of line were in operation. Among the countries of Europe this mileage is exceeded only by that of the U.S.S.R., but the intensity of network, the density of traffic, and the technical standard are considerably higher in Germany than in the U.S.S.R.

In 1937 Germany possessed a fairly intense network whether judged on the basis of miles of track per 100 square miles, or per 10,000 population.

	Total mileage	Mileage per 100 sq. miles	Mileage per 10,000 population
Germany (1937)	33,878	18·6	5·6
Austria	4,125	10·8	6·7
Poland	5,109	14·1	5·0
France	26,094	12·6	6·6
Belgium	3,243	27·5	3·9
Netherlands	2,075	15·3	2·3
Denmark	3,054	18·5	8·1
U.S.A.	251,819	8·3	18·6
U.K.	20,682	21·5	4·4
U.S.S.R.	52,854	0·7	3·1

From: *Statistique internationale des chemins de fer, 1938* (Paris, 1939).

Of the larger European railway systems that of Great Britain is most nearly comparable with the German network in density of traffic and conditions of working. The following table reveals the comparative position under a number of general headings:

Plate 41. A railcar express passing through the Franconian Forest

The train is near Probstzella (1,130 ft. altitude), on the Leipzig—Nuremberg route via Bamberg, one involving heavy gradients. In the background is Lauenstein Castle (1,805 ft. altitude).

Plate 42. A Henschel-Wegmann steam streamlined locomotive near Dresden

This locomotive is a specially designed 4–6–4 tank; a maximum speed of 114·9 m.p.h. has been claimed for it.

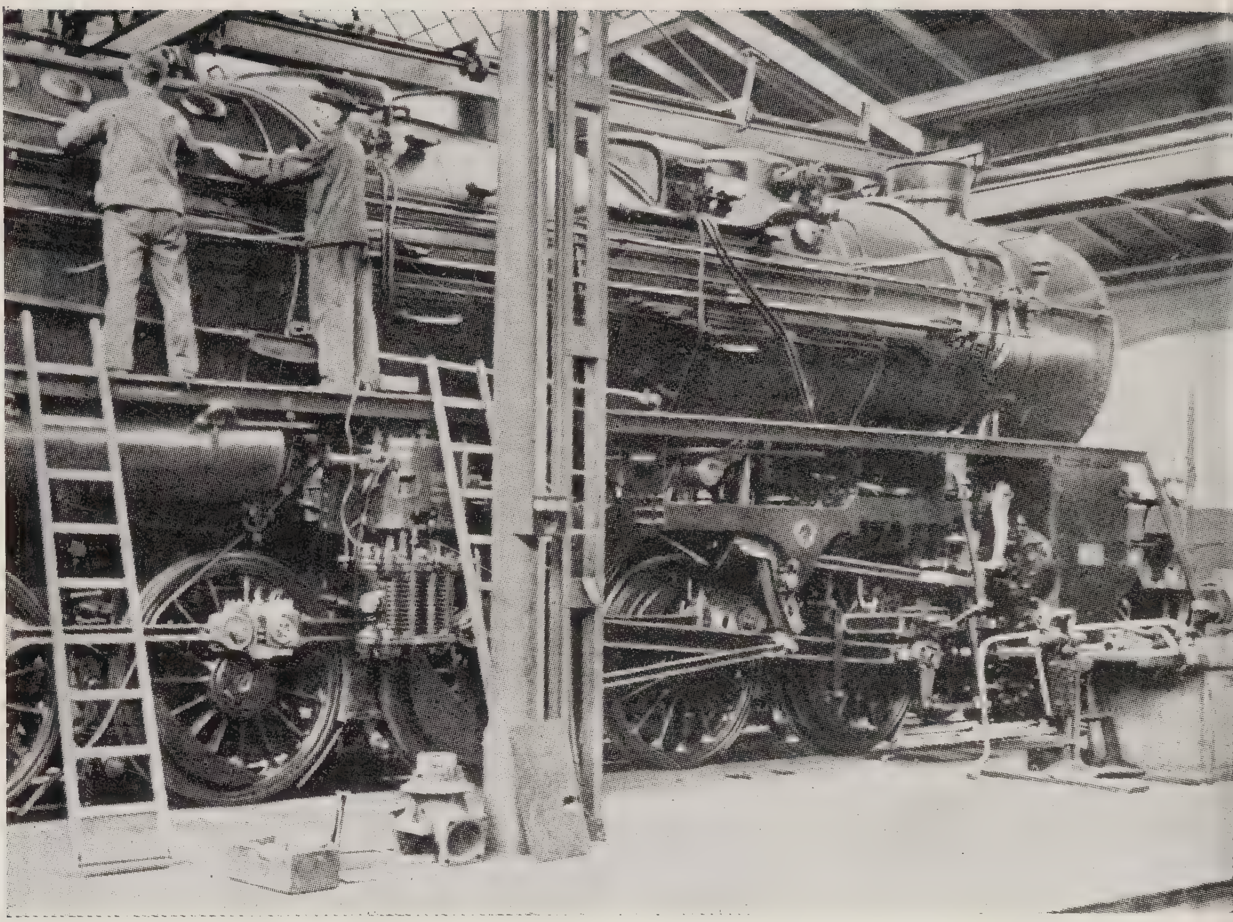


Plate 43. Overhauling a heavy 2–10–0 goods locomotive

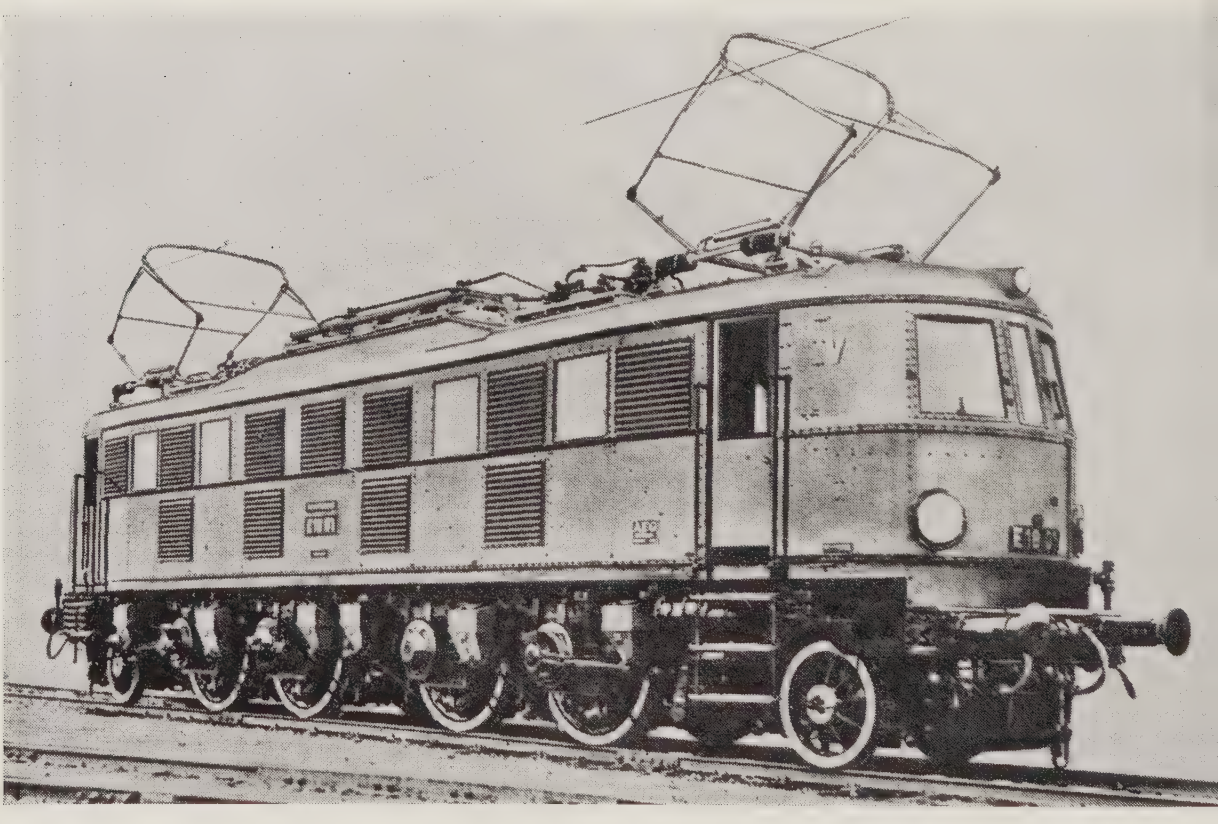


Plate 44. One of the latest types of main line electric locomotive

Comparison of German and British Railway Systems, 1927

	Reichsbahn	British railways
Capital outlay, £ million	1,274	1,211
Return on capital, %	2·6	3·9
Route mileage	35,625	20,242
Track mileage	74,963	51,703
Capital per route mile, £	35,783	58,800
Locomotives, number	24,895	24,098
Coaches, number	62,347	51,465
Staff, number	704,016	628,509
Passenger journeys, million	1,909	1,651
Tonnage of freight handled, million tons	430	325
Operating expenses to revenue, %	82·53	80·83
Passenger receipts per train mile, pence	72¾	64½
Goods and mineral receipts per train mile, pence	260¼	204½

Based on official sources.

The railways of Germany cost much less to build per mile than those of Great Britain. The British track mileage per route mile is greater than the German, implying more double track in proportion. British railways have made a more liberal provision of locomotives, coaches and staff per route mile. It must be borne in mind, however, that they carry on many ancillary services such as the docks, hotels and cartage not provided by the Reichsbahn, and these services employ considerable personnel. The British railways, per route mile, are used more intensively and provide a higher revenue than the German system.

In general, Germany enjoys a geographical make-up and position which give her an advantage over several continental neighbours in railway construction and operation. Coal is cheaper and more widespread, and steel is cheaper than in France or Italy. While extensive tracts are thinly populated and provide little revenue, the general distribution of industrial districts, cities and seaports is such that most main lines carry an adequate, if not a heavy traffic. The position of Germany in Europe permits the connexion of the railway system with the systems of eight other countries, a connexion which favours both the operation of through train services and the movement of trade across the frontiers. Geographically, the German railway system is well laid out, for topographical features have not prevented railways from penetrating the most isolated regions, though not without sharp curves and heavy gradients. Traffic flows with almost equal facility across the plateaux or uplands of the south and in the North German Plain. The valleys of the Rhine, Weser, Elbe, Oder and Danube provide ready-made routes for the railways to follow,

although the rivers themselves provide formidable barriers when they have to be crossed.

The absence of any one centre of attraction, such as Paris constitutes in France, has saved Germany from the inconveniences of excessive centralization of railway administration and has allowed the greatest possible flexibility in the adaptation of services to local requirements. The German railways, more than those of neighbouring countries, are centralized in administration but decentralized in functioning, and this results in unity of management and in flexibility of operation.

Historical Background

'It was the railways which first shook Germany out of its economic stagnation, completing what the Zollverein had merely begun.' Treitschke may have over-emphasized the consequences of railway construction, but the new era which dawned in 1835 undoubtedly influenced all the former habits of life so vigorously, that within a decade Germany had begun to assume a completely different aspect. Many parts of the country had few waterways, and the road system was scarcely developed, so that apart from the traffic which had for centuries been confined to a few historic water routes, notably the Rhine, heavy freights might only be transported for short distances. There was, therefore, little profit to be derived from emancipating laws and the Customs Union if bulk commodities were economically immovable. Although road construction was everywhere in its inception, amid this period of economic transformation, railway dreamers were abroad who were restless to launch schemes which threatened to supersede even the new high roads and revolutionize transport. Such ideas were the more remarkable in a country which had no great reserves of capital and no effective central government.

The Forerunners of the First Railways

The earliest known tramway made of wood, with wagons running on flanged rollers, had been laid in a Siebenlüngen gold mine in the latter half of the sixteenth century, where it continued to work for over 200 years. It was followed in 1775 by a cast-iron tramway laid in a Klausthal mine, while forty years later a German-built locomotive was working in a Berlin foundry yard. This locomotive was built by Krigor and was intended for drawing coal from the Königshutte in Upper Silesia. In 1816 it was on view in Berlin, but its end was uncertain and characteristic of the indifferent spirit of the time.

In 1828, two years before the opening of the Liverpool—Manchester line, Gerstner had constructed the Budweis—Linzer railway in Bohemia, but this line, which served merely for the transport of salt from Salzkammergut, was worked by horses, and as a means of communication was of little value.

The Work of Friedrich List

In 1830, Motz, who played an important part in the creation of the Zollverein, planned a railway connecting the Rhine and Weser basins from Wesel to Rheine, in order to evade the payment of Dutch Rhine dues, and in the following year the Westphalian *Landtag*, with the same desire, asked for the construction of a line from Lippstadt to Minden on the Weser. Three years later, the Rhenish Diet proposed a line from the Belgian frontier to the Rhine and the Ruhr, and another from Elberfeld to Rheine, while Fritz Harkort, a Westphalian industrialist, planned a railway from Köln to Minden. Numerous other projects were put forward but they were, of necessity, nebulous and premature.

Friedrich List, the real father of the German railways, had emigrated from Germany to the United States, where he constructed a 21-mile mineral line amidst the Blue Mountains. List was inspired to dream of a German railway system. He had earlier planned a Bavarian system, and in 1833 settled in Leipzig, having concluded that a pan-German system could best be initiated by a Leipzig-Dresden line. With the aid of Harkort he published an important pamphlet * which included a map 'das deutsche Eisenbahn-system', (Fig. 42). This map represents a noteworthy economic prophecy, for List outlined practically the frame of the present German railway system, the main lines and their connexions being traced out at a time when Great Britain was able to show but a few isolated lines. List pursued this aim of a pan-German system in Leipzig and later in Prussia at Magdeburg. The Prussian government, however, was hesitant, for the state was still very badly equipped with roads, and the Minister of Posts opposed the scheme. Nevertheless, List's plans had taken root and were slowly germinating. He had foreseen, though no Prussian, that the bulk of the lines would radiate from Berlin—six was his number and six there were twenty years later, by which time most of the other trunk lines that he planned had been

* 'Ueber-ein Sächsisches Eisenbahn-system, als grundlage eines allgemeinen deutschen Eisenbahn-systems und inbesondere über die Anlegung einer Eisenbahn von Leipsic nach Dresden.'

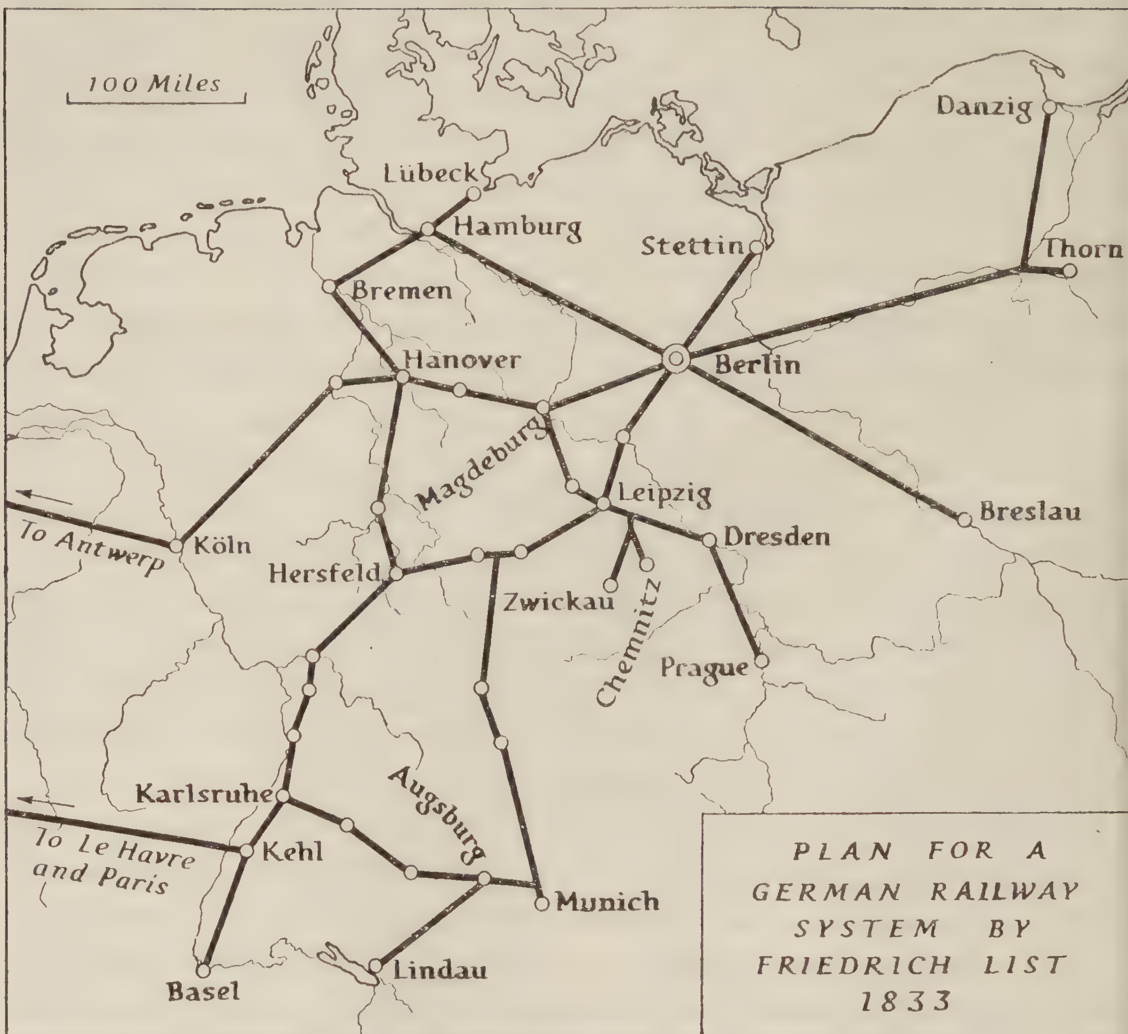


Fig. 42. List's plan for a German railway system (1833)
Based on Lenz, F., *Friedrich List*, p. 429 (Munich and Berlin, 1936).

built, though he himself only lived to witness the completion of the first (Leipzig—Dresden). He was forced to leave Germany by his opponents, and, having been disappointed, impoverished and even persecuted, committed suicide.

The Earliest Railways 1835–9

On 7 December 1835, before any of List's plans had been embarked upon, the first locomotive railway was opened in Bavaria between Nuremberg and Fürth.* The line largely owed its construction to King Ludwig and the Nuremberg bourgeoisie. All this was achieved, despite the fact that there was no expropriation law in Bavaria at the

* The line which, it was said, 'founded the German Empire' (Wilhelm Raabe). The first engine on this line, named *Der Adler* (the Eagle), was built by Robert Stephenson and manned by a British crew. It was joined in 1838 by *Pfeil* (Arrow), also built by Stephenson.

time,* and in spite of exorbitant demands from landowners which the promoters succeeded in overcoming. Whereas most of the early British and French railways existed primarily for the transport of coal, the *Ludwigsbahn* carried no freight for at least six months after it was opened, its first 'goods' being two barrels of Bavarian beer.

The first section of the Leipzig—Dresden line followed in 1837 (Leipzig to Alten) and the example set by these early pioneers quickly spread abroad, bringing proposals from other quarters in Prussia and a committee was formed to clarify the attitude of the state. The discussions, which were prolonged, resulted in the Prussian Railway Law of 3 November 1838, which was compiled before any important line on Prussian territory had been undertaken. Meanwhile, in Saxony, List's first line was rapidly nearing completion. He had planned a direct route from Alten to Dresden by way of Meissen and the basin of the Mulde, though on account of the difficulties of relief a more devious route was finally selected passing across the Elbe lowlands by way of Riesa. The work included a cutting at Machern and the Oberau tunnel (1,683 ft.), and on 7 April 1839, the whole section of 71·75 miles was completed and the first train passed from Leipzig to Dresden. The venture exceeded the boldest expectation, and in its first year the line carried 412,000 passengers, receipts amounting to 102,000 marks. Extensive freight did not develop until branch approaches had been constructed. The German lines which were to follow copied the Leipzig—Dresden line in adopting Stephenson's English gauge.†

In Prussia, too, railway construction was beginning to develop and a number of companies had come into existence under the terms of the new law. These were the Düsseldorf-Elberfeld, the Berlin-Köthen and Berlin-Stettin. At this time the influential citizens of Köln were planning the indispensable trunk route eastward to Magdeburg via Minden, and the merchants of Magdeburg planned lines to Berlin via Köthen and to Hamburg. The line from Köln to the Belgian frontier and thence to Antwerp was to prove of great value to the Rhineland trade, for it would successfully elude the Dutch tariff, and would bind Belgium more closely to Germany.

* The first expropriation law in Bavaria was passed in 1837.

† Except Baden. On 28 September 1836, Bavaria decreed that the 4 ft. 8½ in. gauge was to be used throughout, but the Grand Duchy of Baden adopted the broad gauge of 5 ft. 3 in. for its railways and even drew up a general programme with the Belgian, Swiss and other lines in competition with the standard gauge railway on the left bank of the Rhine. The conversion to standard gauge was completed by 1855.

When Frankfurt took part in the movement for railway development, fierce disputes arose as to which river-bank was to be followed from Frankfurt to Mainz. Hesse-Darmstadt favoured the left bank, and Nassau the opposite shore, the more thickly populated, and this side was finally chosen, as a bridge was still regarded as impracticable. The possibilities inherent in railway construction became more widely realized: Nagler, the Postmaster-General, and hitherto the railway's bitterest enemy, now desired to use postal funds to construct lines whose profit would be turned over to the Post Office.*

Meanwhile transit and transport increased beyond expectation, goods traffic being more lucrative than passenger traffic; the power of distance was being broken; industrial regions such as Upper Silesia developed rapidly and the consumption of iron was nearly doubled between 1834–9. The ironworks soon secured cheaper coal, German rails came to supersede British rails and cheap freight enabled the nation to enter into effective possession of its coal and iron fields. 'Germany had learned her lessons from England and was now rapidly thrusting her teacher aside.' Carriage and locomotive factories sprang into being, and Borsig, who had for a time directed Egells' iron foundry, erected his own locomotive factory in Berlin. In Nuremberg the little carriage shop of the Fürth railway developed into the factory of Klett and Cramer.

By December 1839, about 500 km. of line had been built throughout Germany. Apart from the Leipzig—Dresden link of 110 km. through Saxony, most of the lines were short and constructed more often by state rather than by private enterprise. The first railway constructed on Prussian territory, between Potsdam and Zehlendorf, was opened on 22 October 1838, the connexion to Berlin being made in the following year, while the first German state railway, Brunswick to Wolfenbüttel, was completed on 1 December. Although on a map (Fig. 43) these early fragments of line appear scattered apparently piecemeal throughout the Confederation, many ultimately became the foundation sections of the great trunk routes, which were to grow so rapidly in the next twenty years.

The Construction of the Trunk Network (1840–60)

By 1840 the suspicions of governments were being allayed, and concessions greatly increased. The Prussian state began to give direct

* Nagler's chief line was to have been from Halle to Kassel through the Golden Aue with branches to Erfurt, Weimar and Gotha. The ancient commercial route through Thuringia by way of Erfurt and Gotha was to be disregarded, for the new project would have a larger mileage in Prussian territory.

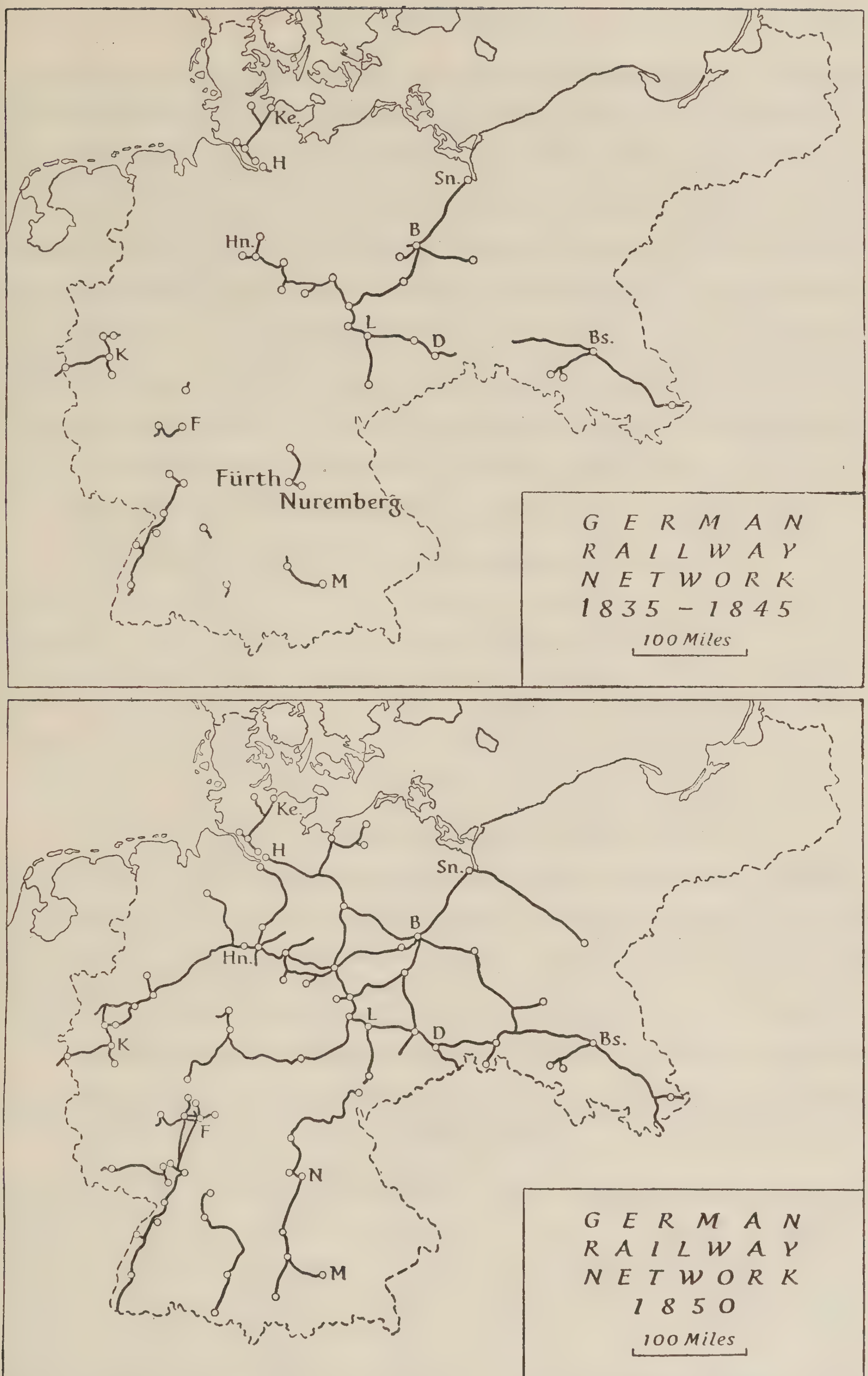


Fig. 43. The first fifteen years of German railway construction

Based on *Hundert Jahre Deutsche Eisenbahnen*, p. 16 (Berlin, 1935).

B Berlin; Bs. Breslau; D Dresden; F Frankfurt-am-Main; H Hamburg; K Köln; Ke. Kiel; L Leipzig; M Munich; N Nuremberg; Sn. Stettin.

assistance to railway building, and, after 1842, finding the exchequer full, planned over a thousand miles of line, offering a guarantee of interest to the constructing companies whenever the prospects of attracting capital were poor. In the same year, a law was passed in Hessen (Hesse Darmstadt) authorizing the establishment of state railways: Württemberg followed in 1843, opening the line between Cannstadt and Untertürkheim, and Bavaria in 1844 (Nuremberg and Bamberg). Only in the central and western provinces did private capital fall a prey to speculation (after the English example). Here 118 new companies were formed in 1845 and plans were afoot for 1,263 additional concerns with a capital of £562,000,000, but speculation was soon prohibited, although building was pressed on.

Cost of land per acre on the principal German railways, 1848

Company or Administration	Cost of land per acre (£)
Baden	143·0
Upper Silesia	47·0
Berlin—Frankfurt-am-Main	69·2
Anhalt	63·0
Berlin—Stettin	46·0
Magdeburg—Leipzig	53·5
Düsseldorf—Elberfeld	70·0
Köln—Belgian frontier	93·5
Saxon—Silesian	53·0
Nuremberg—Fürth	—

From: D. Lardner, *Railway Economy*, p. 479 (London, 1850).

There was a considerable dependence upon foreign countries in the early phases of railway construction, not only for capital to build the lines, but in engineering and locomotives. In the early forties there were 240 locomotives in Germany, of which 166 came from England, 12 from Belgium, 29 from the U.S.A. and only 38 from Germany. Railway track also was to a great extent imported.

Cost (*in* £) *of construction per running mile on each of the principal German railways*, 1848

Company or Administration	Surveys and land	Earthworks	Permanent Way	Total
Baden	1,445	3,478	2,625	11,764
Nuremberg—Fürth	829	163	1,800	4,177
Munich—Augsburg	1,042	3,485	2,966	9,055
Berlin—Frankfurt-an-der-Oder	920	1,365	2,272	7,518
Berlin—Stettin	550	1,770	1,835	6,268
Berlin—Potsdam	1,940	2,110	2,760	12,526
Berlin—Köthen	607	2,020	2,485	7,050
Magdeburg—Halberstadt	616	650	2,170	5,273
Bonn—Köln	1,965	885	2,118	7,417
Saxon—Bavarian	1,085	3,850	1,854	9,330

From: D. Lardner, *Railway Economy*, p. 479 (London, 1850).
The total includes the cost of stations, stock etc.

Among the more important lines planned by Prussia at this time were the Rhine-Weser, to link the two river-basins: a Posen line for Prussian Poland: the Thuringian line to link Prussia with the south: the Berlin—Breslau line which joined the capital to the coalfield and the critically strategic area of Upper Silesia: and the Berlin—Hamburg line, after the Mecklenburgs and Hamburg had contributed considerably larger sums than Prussia. This particular section of line illustrates some of the many difficulties which had to be faced in order to secure powers to join important centres by railway wherever the intervening course traversed the territories of a number of small self-governing states. The construction of the Berlin—Hamburg railway involved concessions from Prussia, Hamburg, Lübeck and Denmark (the king of Denmark then being the ruler of the Duchy of Lauenberg). The routes to be followed by the important Prussian lines westward from Berlin were still unsettled, however. Fortunately, Brunswick had constructed the Brunswick—Wolfenbüttel—Harzburg line (the first state railway) which became the foundation of the great Spree—Rhine link. In the east junctions with the Prussian lines were formed by separate companies: in the west, with Hanover. Prussia wanted the westward route to Hanover by way of Neustadt so that a branch connecting Westphalia might be laid from Nienburg to Bremen. The Guelph ruler objected, preferring a more southerly route from Hanover to Minden—an extremely long and inconvenient line, but one which would lie exclusively on Guelph territory. This line was actually built, and later, the trunk line from Minden to Köln was connected with it. By 1845, Berlin, Magdeburg, Dessau, Brunswick and Dresden were all linked and the Köln—Aachen line was joined to the frontier of Belgium.

Two years later, the French were constructing a trunk line along the frontier near Forbach, while a company in the Bavarian Palatinate were building through the hills of Westricht to Neunkirchen. The two lines were only separated by a narrow strip of Prussian territory in which lay the Saarbrücken coal basin. Prussia, therefore, constructed in 1851 her first state railway, the little Saarbrücken line, which was to become one of the greatest economic importance. In the same year the important trunk line to the east was planned from Berlin to Königsberg via the Warthe and the Netze through Landsberg and Bromberg.

In the minor states of the confederation the activity was greater still, but only Brunswick and Baden (remembering the Frankfurt experiences) decided on entire state construction. In Baden, where

the plans were not well carried out, a local gauge was adopted lest foreign wagons should cross the sacred frontier, while the busy manufacturing town of Lahr was left off the state route, on account of its liberal sentiments. The same petty factions were at work, too, in the construction of the Main-Neckar railway agreed upon with Hesse. This line did not run directly through the thickly populated regions of the Upper Bergstrasse to Heidelberg, nor did it take the westward route to Mannheim. Instead, midway between these two disfavoured cities, an unwisely chosen junction was effected at Friedrichsfeld. In Württemberg, the state constructed a line parallel to the Augsburg—Lindau line from Ulm to Friedrichshafen to prevent Bavaria from monopolizing Lake Constance.

Bavaria also decided for state action, but the isolated Palatinate territory, being wealthier, was more successful with private enterprise. Saxony, desirous of obtaining all the advantages derivable from transit trade, brought forward a plan for communications with Silesia, Bohemia, and Bavaria, but the state had to carry out the construction. In Hanover, however, where industrial capital was unknown, the state constructed two lines from Hamburg and Bremen to Berlin. In the Electorate of Hesse, where it was hoped that Kassel would be the centre of a German network, grandiose designs were entertained, which were marred by the sloth of the Prince Regent. At length, a joint-stock company joined Thuringia to Westphalia, the favour of the king being secured by the name 'Frederick William Northern Railway'. Hesse-Darmstadt built the Main-Weser line from Kassel to Frankfurt.

Frankfurt-am-Main, then a free city, had hoped to regain a part at least of its old medieval trade ascendancy, diminished through opposition to the Prussian customs policy, by becoming the centre of several important railway routes. Their construction, however, was particularly slow on account of political conditions, in which disagreements between royal and ducal families played a great part. The short line from Frankfurt to Wiesbaden passed through three states and the discussions over it lasted as many years. This, however, was expeditious work compared with that involved by the short Frankfurt-Homburg line over which fourteen years of negotiation were to elapse. Even after this delay the principality of Hesse would still not agree, for it feared that a railway to Homburg would enable that town to harm the trade of her own spa, Bad Nauheim, and the railway was finally constructed outside Hessian territory.

Before long, four great groupings came into being which tended to

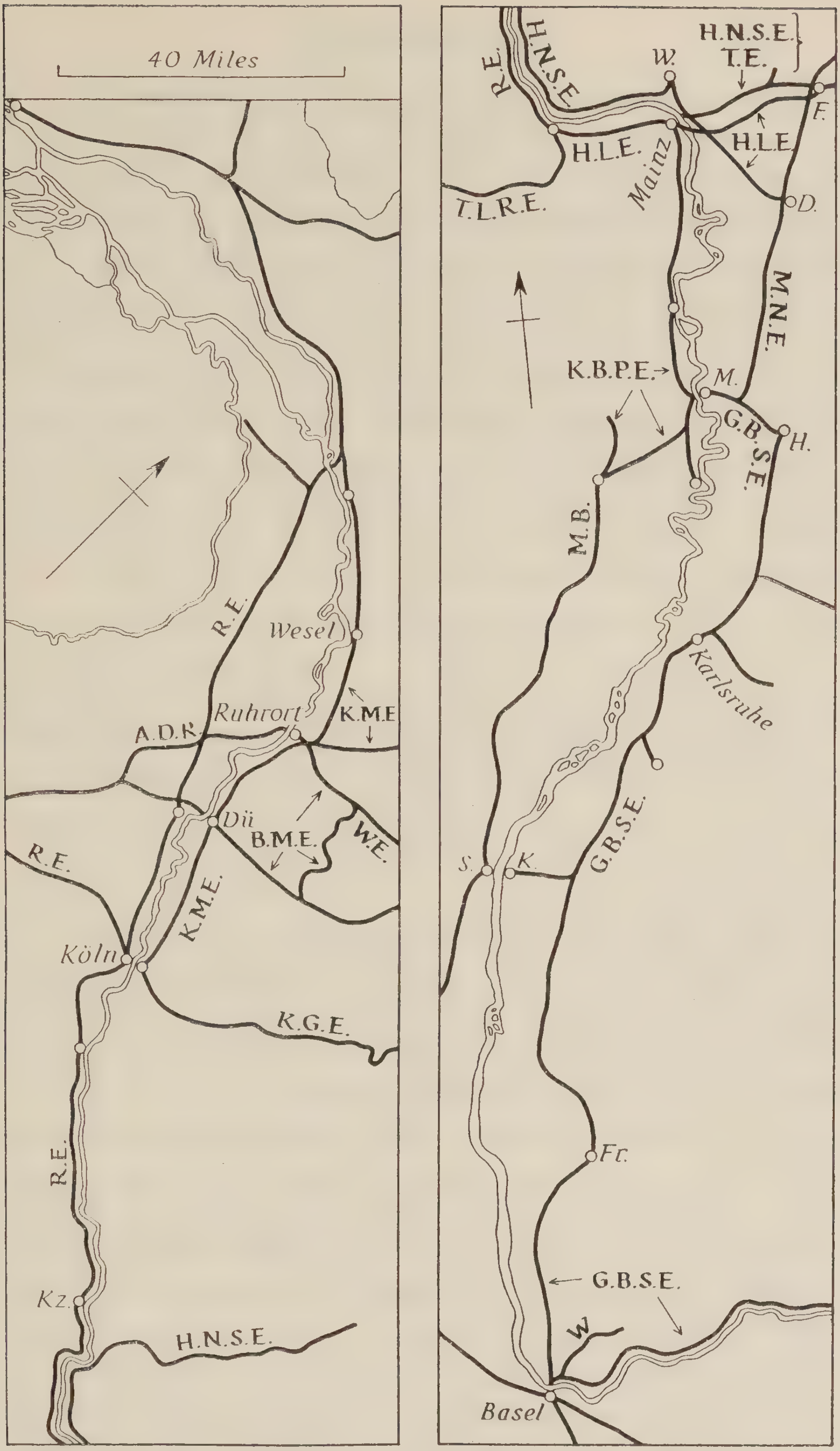


Fig. 44. Railways in the Rhine valley, 1866

Based on Bradshaw's *Map of the Rhine from Rotterdam to Schaffhausen*, in *Bradshaw's Continental Railway Guide*, no. 227 (London, April 1866).

A.D.R. Aachen, Düsseldorfer Eisenbahn; B.M.E. Bergisch, Markisch E.; G.B.S.E. Grosherzöglich Badische Staats E.; H.L.E. Hessische Ludwigs E.; H.N.S.E. Herzöglich Nassauische Staats E.; K.B.P.E. Königlich Bayer Pfälzische E.; K.G.E. Köln, Giessner E.; K.M.E. Köln, Mindener E.; M.B. Maximiliansbahn; M.N.E. Main-Neckar E.; R.E. Rheinische E.; T.E. Taunus E.; T.L.R.E. Trier, Luxemberger, Rhein Nahe E.; W Wiesenthalbahn; W.E. Westphälische E.

D. Darmstadt; *Dü.* Düsseldorf; *F.* Frankfurt; *Fr.* Freiburg; *H.* Heidelberg; *K.* Kehl; *Kz.* Koblenz; *M.* Mannheim; *S.* Strasbourg; *W.* Wiesbaden.

suppress the spontaneous anarchy of petty companies: a North German group, based upon Berlin; a lower Rhenish group, based on Köln; a Bavarian group, based on Augsburg; and a south-western group, based on Frankfurt. Within these unions, freight and common working principles began to be standardized. By the early fifties, the railway pattern was very unequally distributed (Fig. 43) according to the unequal distribution of population, commerce and industry. The line from Köln to Basel was complete and in operation, short branches being thrown off at various points to reach centres of population which did not lie in its direct course, e.g. Baden, Mannheim and Speyer. From Stuttgart in Württemberg a line went northwards to Heilbronn, branches being proposed from here to Frankfurt and Karlsruhe, and southwards to Ulm and Friedrichshafen on Lake Constance. (The line across the Alps by the Splügen Pass to Italy was projected though not yet built.) From Munich in the Bavarian system a line had been laid northward via Augsburg, Donauwörth, Nuremberg, Bamberg, Lichtenfels to Hof, where it united with the Saxon system, and so reached Leipzig. This trunk threw off several branches east and west, one being in progress through Würzburg to Frankfurt-am-Main to connect with the Rhenish trunk.

Berlin was already the centre of a broad network over the North German plain, while building had not yet commenced upon a great number of other lines which had been projected, especially in the tract of country between the Weser and the North Sea. Besides Berlin, Dresden and Hanover already formed two secondary centres of divergence in the North German system.

By 1855, the German through routes were much further advanced than the French, about 4,600 miles of track being open, compared with 2,000 miles in France. There was now continuous communication from Munich to Leipzig, and from Basel to Mainz, though the Rhine narrows from here to Bonn were not yet provided with a line. At Leipzig, a traveller from the south struck the almost completed trunk lines of northern Germany. He could get to Berlin and from thence to Hamburg: or to Magdeburg, Hanover, Düsseldorf and the Lower Rhine: or to Halle, Weimar and Kassel: or to Frankfort-an-der-Oder and to Silesia, Cracow and Teschen, or Stettin and the Baltic, though the great eastern line to Königsberg and Danzig was not yet in operation. From Hanover one could also reach the Lower Rhine (at Düsseldorf and Köln), Bremen, or Harburg, but the Hanover—Göttingen—Kassel—Main valley trunk was still under construction. Whereas a traveller arriving in France at Calais, Havre

or Brest could not have got through to any point on the French north-eastern or southern frontiers, on arriving at Bremen, Hamburg or Stettin he could cross the country to Cracow or Prague, to the French frontier near Köln, and to the southern frontier near Munich. Germany was thus far ahead of all her continental neighbours with the sole exception of Belgium, where distances were much smaller.

By 1860, 11,300 km. had been constructed and the net increase of the period was approximately 10,800 km. The German lines formed by far the most impressive network of railway in continental Europe. The trunk lines, which by now were almost complete, resolved themselves into a definite pattern; three ran from west to east and three from north to south.

Trunk Lines, 1860

Routes from west to east:
(1) Across the North German plain (Aachen—Berlin—Königsberg)
(2) Through central Germany (Essen—Dresden—Beuthen)
(3) Through south Germany (Mannheim—Munich—Vienna)
Routes from north to south:
(1) In the east (Stettin—Berlin—Prague)
(2) In the centre (Hamburg—Kassel—Munich)
(3) In the west (Köln—Basel)

The construction of the primary network, witnessing both the genesis of the industrial revolution in Germany and the growth of the Zollverein, made both possible. In a country whose road system was still new and very imperfect, and whose towns were mostly small and half rural, its revolutionary influence was far more conspicuous than in more urbanized and earlier developed lands.

The Construction of the Other Main Lines (1861–75).

By 1861, the principal trunk routes having been almost completed, the next fifteen years were characterized by a rapid development of the main-line network, much of which, after 1871, was constructed by way of French war indemnities, rather than by German thrift. Internal and external trade, which rapidly increased in importance,* owed much to this development of communications, in which the activity of those private companies which built and worked a large part of the new construction is proof of the rapid accumulation of

* Trade would have increased more rapidly had there been less inter-state and company rivalry. Even after 1871 the state frontiers still caused operating difficulties, e.g. for many years all passenger traffic had to stop at Offenbach in consequence of an agreement made in 1868, between Prussia and Hesse, as a result of which expresses from Frankfurt to Hanau had to be routed another way.

capital at the time, and private initiative may be said to have dominated the critical years from 1865 to 1875.

The states continued with an unsettled and badly-planned policy of railway construction, and acted in accordance with the requirements of the moment. Wherever private companies came forward, construction was left in their hands, but in cases where important strategical or commercial railways were not undertaken privately, the

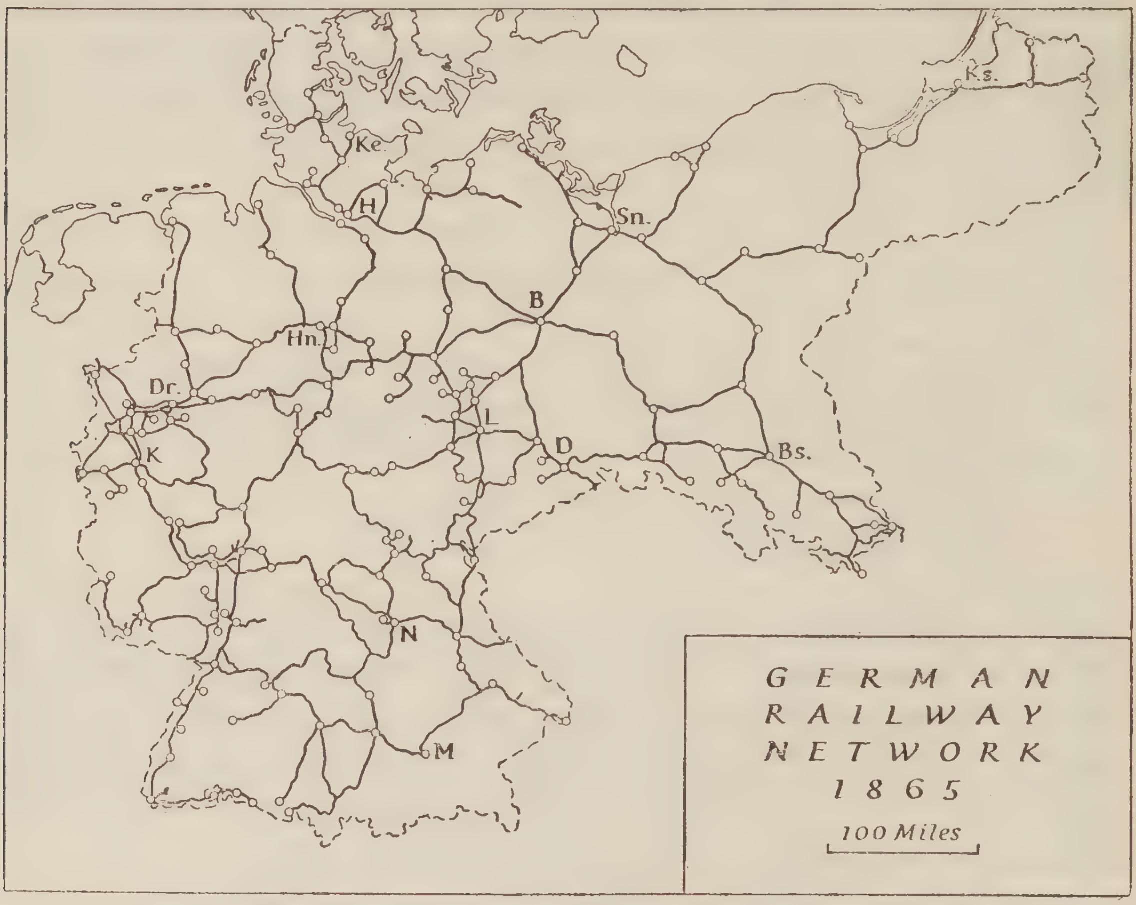


Fig. 45. The first thirty years of German railway construction

Based on *Hundert Jahre Deutsche Eisenbahnen*, p. 24 (Berlin, 1935).

B Berlin; Bs. Breslau; D Dresden; Dr. Dortmund; H Hamburg; Hn. Hanover; K Köln; Ke. Kiel; L Leipzig; M Munich; N Nuremberg.

government might induce a private company to come forward by offering financial assistance, or itself construct the lines. In Prussia especially, the state continued to rely mainly upon the spirit of private enterprise for the construction, operation and management of the railways.

Construction developed on principles analogous to those in America, just as there were certain technical comparisons between German and American railway methods. Single lines with passing loops were frequently considered sufficient, for the amount of traffic on many of the main lines was as yet small, when compared with

railway traffic in Great Britain or Belgium. Deep cuttings, earthworks, viaducts, bridges and tunnels were not attempted on any large scale as 'the railways had been carried more along the natural level of the country', and for this reason short radius curves and heavy gradients are far more frequent than in Great Britain. Whatever difficulties may have been met with in operating such lines, the construction costs of the German network were remarkably light. Like America, Germany had constructed her railways quickly and cheaply; land was cheap, while a growing population, together with the decay of rural industries, provided the necessary labour at very low rates. Thus while the average cost of lines opened by 1865 was estimated at £10,000–£11,000 per mile, it had exceeded £16,000 in Belgium and varied from £30,000 to £50,000 in England.

Main features of the network in 1875. In the centre and south, where state enterprise had nearly always predominated, a well-balanced network was apparent by 1865. The importance of the Ruhr area was already noticeable, due both to the development of industry, and the junction of those routes which lay along the Rhine valley, with those extending westwards from Berlin to Holland and Belgium.

There was a dense network on either side of the Upper Rhine valley between Frankfurt and Karlsruhe. Here the Rhine valley traffic was crossed by routes to the French frontier, from Berlin towards Saarbrücken and Metz, as well as by routes from France and Belgium towards the south-east, to Austria and Switzerland. This pattern was the more complicated owing to the considerable inter-state and company rivalry of earlier years which produced a large number of competing lines (see p. 202).

The pattern in Saxony, south of the Leipzig—Dresden line, resulted from the progressive building programme of the Saxon government, which hoped to benefit by the geographical situation of its state at the eastern extremity of Bohemia, and was therefore well placed to profit from the routeway joining south Germany to Silesia and the north-east, which lay through its territory.

In the area around Brunswick, Magdeburg, and Halle a more detailed system had arisen, partly as a result of rivalry between Leipzig and Halle and partly owing to the fact that this country, which lay at the northern edge of the upland, received four important trunk routes from Berlin, and therefore acted as a distributor to Saxony, the whole of south Germany and Switzerland, as well as to France, Belgium and Holland via the Ruhr.

In contrast to these districts the high land on either side of the

Mosel valley and to the south-east of the Ruhr remained comparatively untouched while the industrial basins of the Saar and Silesia had not yet greatly affected the railway lay-out in their immediate vicinities. On the northern plains, the pattern was essentially one of radial trunk lines from Berlin with intersecting lines from north to south which produced an open triangular network from the Dutch frontier to East Prussia.

By 1875, nearly 28,000 km. of line had been completed, most of it normal gauge track, and the net increase since 1871 was approximately 15,800 km., practically all of it main-line track, while an additional 840 km. were acquired by the annexation of Alsace-Lorraine. The construction of the main-line network was executed at considerable speed and in the decade 1865–75 13,200 km. of track were laid, the highest figure for any ten-year period in the history of any European railway system.

The Construction of the Branch Lines (1876–1919).

In 1876, the German railways were still divided in 63 administrative or operational districts and provinces. Nevertheless, much had been accomplished. Uniform signalling regulations had been introduced and a permanent commission on rates and fares was appointed in 1878, and uniform standards for the construction of equipment of main-line railways were also adopted. The trunk and main-line networks were complete, and by the eighties, about 34,500 km. of track had been laid. Prussia was by now actively fostering state ownership by the acquisition of many lines both within and outside her own territory, but the complete picture of the German railway system was now of extreme complexity, especially with regard to ownership and operation (see p. 212).

State and Private Railways in Prussia, 1879–1909 (*Track Length in km.*)

Year	State Railways	Private Railways	Total
1879	6,323·6	13,950·1	19,973·7
1880	11,455·3	8,893·1	20,348·4
1881	11,584·6	9,159·2	20,743·8
1882	14,825·6	6,329·8	21,155·4
1883	15,301·1	6,604·2	21,905·3
1884	19,766·9	3,002·6	22,769·5
1885	21,138·4	2,496·6	23,635·0
1895	25,214	—	—
1900	27,513	—	—
1909	37,400	2,900	40,830

From: J. H. Clapham, *Economic Development of France and Germany*, 1815–1914 (Cambridge, 1936), and J. Ellis Barker, *Modern Germany* (London, 1919). No figures are available for the last two columns for 1895 and 1900.

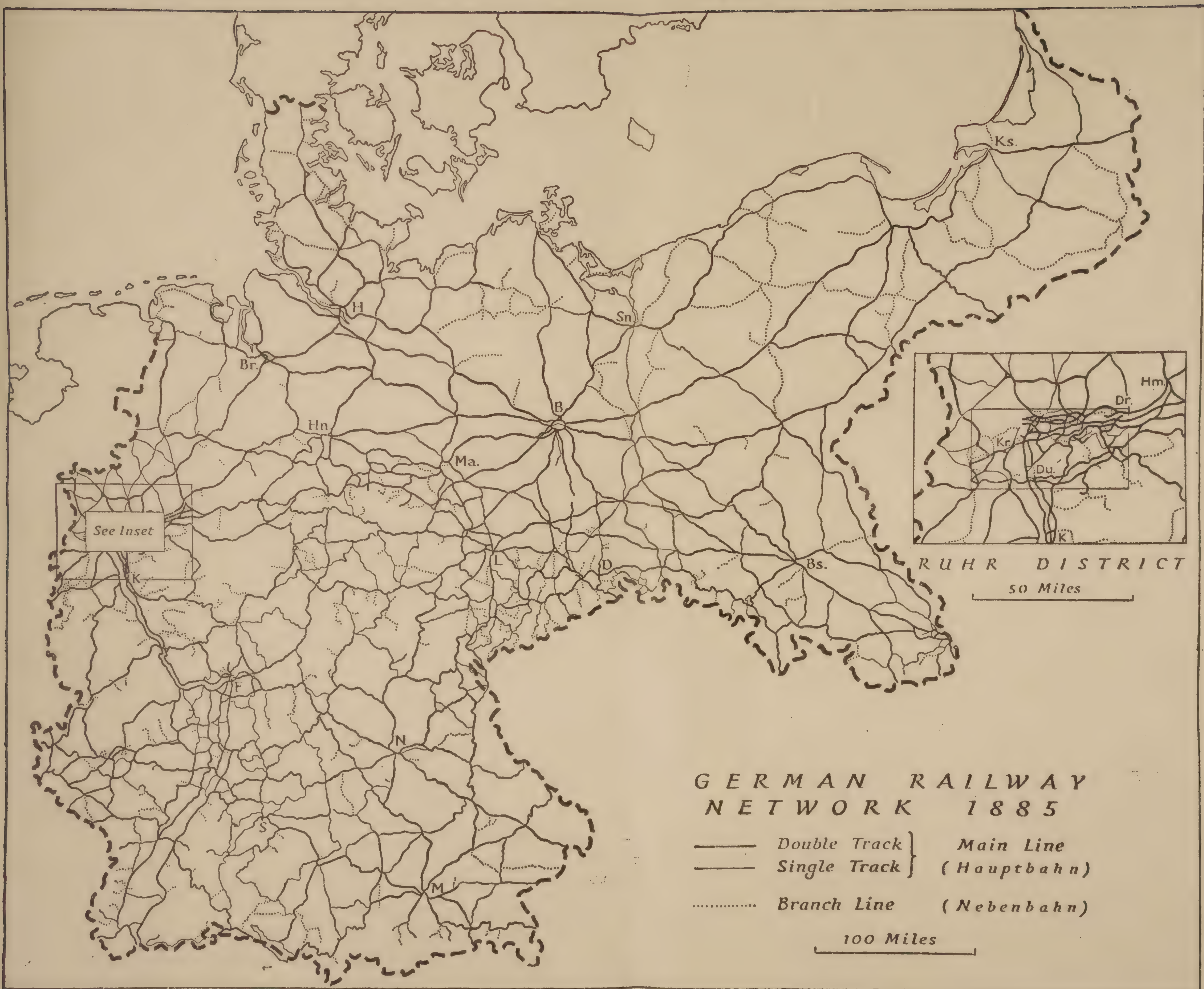


Fig. 46. The first fifty years of German railway construction

Based on a folding map in *Hundert Jahre Deutsche Eisenbahnen* (Berlin, 1935).

B Berlin; Br. Bremen; Bs. Breslau; D Dresden; Dr. Dortmund; Du. Düsseldorf; F Frankfurt-am-Main; H Hamburg; Hm. Hamm; Hn. Hanover; K Köln; Kr. Krefeld; L Leipzig; M Munich; Ma. Magdeburg; N Nuremberg; S Stuttgart; Sn. Stettin. Note the great increase in main line construction since 1865 (Fig. 45), and the growth of branch lines, many of which were under construction. All the branches were single-track except two: Posen (Poznan)—Schneidemühl, and Lötzen—Lyck (E. Prussia).

By 1880, whereas most of the small speculative companies which had been formed in earlier years were by now dissolved, the more important private companies were not as yet engrossed into the state railways. Accordingly, complete details for the whole of Germany are given relating to 1880, a year in which ownership and operational problems showed the greatest complexity (see pp. 431–2).

In the years following, the history of German railway construction becomes a local and specialized story; a story of the addition of innumerable small, though important, sections rarely over 30 km. in length, more usually from 5–10 km., and these sections, added piecemeal, gradually increased the density of the main network through the country. Now and then some especially significant line would be completed, either internally, as from Warnemünde to Neustrelitz (in 1886), or an external section across the frontier of the Reich which would link Berlin by a more direct or faster route, to some capital or junction—Constantinople, Salonica, Trieste or Marseilles. Thus, although the net increase in track from 1876 to 1919 was nearly 34,500 km., only a small percentage of the construction represented an entirely new section of line. In another respect, however, the construction in this period was of the greatest importance, for much of the track laid after 1876, and especially after 1900, represented the duplication of track which had hitherto been single line, and in many cases the quadrupling of important sections near the important frontier districts, at junctions and in industrial areas. No longer, therefore, was it possible to gauge the development of the whole system in any one period, solely by the length of line in operation, but rather by the density and efficiency of the network in relation to its use, and the distribution of population and resources.

By 1910, a very considerable mobility had been achieved, especially between the east and west frontiers, a mobility which would have been impossible but for the careful organization which developed in the early years of the century. In 1914, double-track lines were much more numerous than in France; especially useful was the increase in the number of connecting and crossing railways, stations and loading platforms, and in the punctuality of departure and arrival which operated most favourably for the development of military transport. After the outbreak of war, the most important lines were naturally the east-west trunks: fourteen lines of track crossed the Rhine from Basel to Wesel near the Dutch frontier, while on either side of the great river, the parallel longitudinal tracks made connexion with the east-west routes. Other lines which stopped at the right

bank, from the Black Forest or the Taunus, were of secondary importance, but nevertheless constituted an added number of communicating lines. Of especial importance was the route which had been constructed from Metz via the valley of the Mosel through Trier, Koblenz, Kassel and Magdeburg. This line, which was called the *Canonstrasse*, joined the network which the military staff had built about Metz and was the last link in a series of communications by which Germany was able to penetrate France without traversing Luxembourg or Belgium.

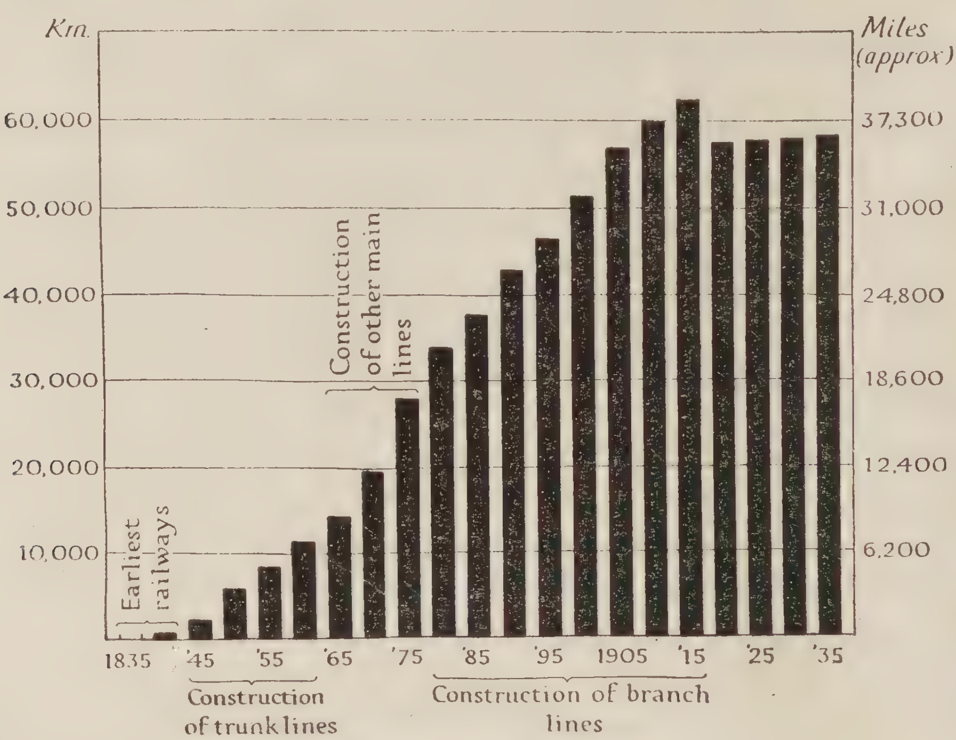


Fig. 47. Total railway mileage, 1835–1935

Based on various sources.

By the complicated Rhine-Westphalia system the large centres of Bremen, Hamburg, Hanover, Magdeburg, Leipzig, Dresden and Berlin could be reached by parallel or diverging routes. A train was therefore able to travel the 1,400 km. from either front within 36 hours, and great efforts were made for the construction of embarkation platforms of sufficient length, handling equipment, and rolling stock with high capacity. At Köln, where the Rhine was crossed by the four-track Hohenzollern bridge, lay the main route to Paris—the route of the 1914 invasion. In the early days of the war a troop train passed through Köln every 10 minutes.

By 1919, however, the four years of warfare had taken a heavy toll. The railways were overworked and maintenance had been neglected.

About 5,800 km. (4,100 miles) of main and branch line were ceded, 2,000 km. (1,240 miles) of it within Alsace-Lorraine, and the total track of the country was reduced to about 34,000 miles. Before the transference of territory the total network amounted to approximately 67,000 km. (41,600 miles). In addition, by award of the Peace Treaties, 8,000 engines, 13,000 coaches and 280,000 goods wagons were transferred to other countries.

Developments since 1919

Since 1919 comparatively little new building has been undertaken, only about 600 km. of track being laid in twenty years. A large percentage of the new track was a duplication of existing sections, the only important new lines being the construction of two new sections for freight traffic only, one serving the Ruhr from Elberfeld to Langenburg, and another along the shores of Lake Constance, Oberuhldingen to Fischbach. The main interests of the period therefore pass from construction to policy and traction—from the gradual disappearance of state and private railways to the emergence of the *Reichsbahn* (see p. 215). An increase in speeds and improved train operation resulted from a development of the permanent way combined with improvements in the design of steam, electric and diesel locomotives (see p. 243).

The Polish Corridor. In April 1921, with the creation of the Polish corridor, conditions were laid down under which the so-called 'privileged' trains were to be run across the Corridor. Trains were only allowed on certain routes, and no fewer than 21 railway lines through the former German territory connecting East Prussia were closed. In 1933, after prolonged negotiations, new agreements were concluded on 14 February between Germany, Poland and Danzig, concerning traffic across the Corridor. This resulted in better transit facilities between East Prussia and the rest of Germany, and with fewer formalities on all sides. Modifications were introduced in the number of axles allowed in the various classes of through trains and in the regulation dealing with breakdowns, conditional timings and routings, and legislation with regard to accidents. Telephone, telegraph and postal traffic was also affected for the better. Regulations were abolished under which carriage windows could be opened only while the train was in motion and this only on the corridor side of the carriages (an intolerable requirement during the summer months). Military traffic, which had been severely restricted in 1921, was allowed to enjoy new facilities, Germany being able to send many

more trains than before. A control office was also set up in Danzig to regulate the working.

Operating districts. Up to 1933, the general organization of the *Reichsbahn* into local district managements was based mainly upon the political boundaries of the different states. There were 30 such districts, all of which reported direct to railway headquarters except for six in Bavaria which were grouped for administration. In more recent years the territorial divisions have gradually lost their special significance and, in 1937, four were merged, reducing the total to 26 (see p. 219). In the same year the Minister of Transport expressed the view that the state or the *Reichsbahn* might assume control over those private railways which still remained. This assumption is being carried out gradually on equitable terms.

In the following year the State-owned Austrian Federal Railways were also absorbed into the *Reichsbahn*, increasing the country's total network to approximately 42,000 miles. Thus some 3,600 miles of track, 305 miles of which were narrow gauge, and 540 miles of electrified line, passed into the German hands. The prosperity of the Austrian railways had fluctuated greatly with the intensity of tourist traffic in the country. In 1936, they had a staff of about 57,000 and carried 52·5 million passengers.

Ownership

The ownership of railways in Germany has gone through several phases, and has reflected several variations of policy. In the later years of the nineteenth century the problem aroused considerable interest abroad. During the first decade of railway building construction was largely carried on by private enterprise, for the states were unwilling to commit themselves at first. In the small states of the west and south the few lines were state railways, but Saxony favoured private enterprise. Prussia at first abstained from interference, but later began to encourage private companies and, in poorer districts, found it necessary sometimes to undertake construction.

During the period 1845–71 the existence side by side of independent private companies, companies over which the state had some control, and railways which were run and completely controlled by the state, greatly reduced the potential value of the existing lines. Many companies charged excessive rates, and at the same time rates underwent violent fluctuations, while the multiplicity of companies impeded the co-ordination of services. However, by the seventies the hand of the state was increasingly felt, though even Prussia owned no

great length of line until Hanover and Hesse-Cassel were annexed in 1866. These annexations, which were followed by that of Alsace-Lorraine, form the prelude to the railway history of the German Empire, for in no other sphere did economics and politics blend more completely than in that of German railway policy.

Transition to State Organization (1871–1924)

In 1871, the whole question of railway ownership required a solution, for despite the regional groupings, the tangle of railway organization and operation was worse than ever. Some years earlier, Bismarck had played with the notion of a universal state-owned system, but now Bavaria would not sacrifice her railway independence, while free trade and private enterprise were an obstacle to nationalization even in Prussia. In 1873, a specially constituted Imperial Division, headed by the Prussian minister of railways, was created to administer the first Imperial Railway (in Alsace-Lorraine), to watch the application of various legal requirements imposed on the railways, and for the purpose of operating the railways in the name of the Empire. An Imperial Railway Office was set up to draft an Imperial Railway Law, though none of its early plans were even brought before the Reichstag, and even in 1876 Germany was still divided into 63 railway provinces or territories.

Bismarck issued an interesting document in which were summed up the evils of private ownership. These were (i) unnecessarily high working expenses and correspondingly high charges resulting from the multiplicity of railway boards, managers, officers and the unnecessary duplication of lines, stations, rolling stock, etc. (ii) Chaos of freight charges—there were 1,400 different tariffs which were constantly changing. (iii) The wilful damage done to passenger and freight traffic by competing railway systems.

In the trade depression of the late seventies which followed, severe criticism of private railway management increased. A period of reckless enterprise was followed by loss and disappointment, and the 'corn-growing squires' of the east grumbled at the 'penetration' rates by which Russian grain moved cheaply over the eastern lines into the heart of the country, while the strategic argument for state management was the more easily appreciated after the diplomatic rapprochement between France and Russia. Bismarck, therefore, who had had to give up the ideas of an Imperial Railway Company, opened his campaign in favour of the management of the Prussian railways by the Prussian state. In 1879 Prussia began rapidly to buy up all the

more important lines, and so thoroughly was the policy carried out that in thirty years the state ownership of lines rose from 26% to 98% of the total length of line.

During this period, twenty of the lesser companies in Germany were handed over to the state concerned; many of these ran across non-Prussian territory. Arrangements for part ownership were in some cases entered into and the government took over some lines over which it was not even part proprietor. In the same period the rolling stock of the country was practically trebled, improved material was built everywhere and travelling made infinitely more safe, more comfortable and more rapid than it had been on the private lines. In the last decade of the century the story was one of the absorption by the states, of state administration and of the triumph of particularism against imperialism. By the eighties Bavaria had absorbed all the private lines, the last private company in Saxony—the Leipzig—Dresden line—passed to the state, and Mecklenburg-Schwerin had nationalized its lines. By 1896 Hesse had followed.

In 1909, besides Prussia's 37,400 km. of state lines, there were 17,000 km. owned by Bavaria and other large states, but only 3,600 km. of private standard-gauge line in the Empire and none of the owning companies controlled any route of first-rate importance. It was not surprising that foreigners constantly spoke of the German state railways when in fact no such thing existed; there were, in fact, a series of state railways. The Prussian state owned the great majority of all the existing main lines, and although the Imperial Railway Office existed to co-ordinate the railways of all the states, the Prussian organization, subject to certain rather stubborn differences with Bavaria, was generally able to dictate its own policy. When lines were bought, provision was regularly made for a new sinking fund to pay off the capital burden, and although new construction was constantly adding to the railway debt, the financial position was always sound and the railways continued in increasing efficiency. Whereas, under private management, railway profits were stagnant and retrogressive, under state management they rapidly became progressive. Profits of 6–7% on the whole railway capital were realized (compared with 3–4% in Britain) and the state made immense profits. There was, however, both in Germany and outside, considerable discussion as to whether this prosperity was real. Critics of state management contended that methods of book-keeping, for example, did not allow of a true comparison with private enterprise.

A rigid military discipline was enforced on the railway personnel.

'Post and Railway' it was said, 'are only the civil sections of the army.' The directors were not infrequently generals and in both services there were 'three-quarters of a million men who stood stiff at attention when their superiors spoke to them'. There was a complete absence of any railway labour movement comparable with those which were developing in France and England in the early years of the twentieth century. Between 1871 and 1914 the railway system had been transformed: services became punctual and frequent, and goods tariffs more reasonable.

By 1914 there were seven individual state railways in Germany under the control of Prussia, Bavaria, Saxony, Württemberg, Baden, Mecklenburg-Schwerin and Oldenburg, and all were prosperous. Even as late as 1917 the railways showed a surplus of R.M. 786 million, but in the course of the next year an operating loss (exclusive of amortization charges amounting to R.M. 1,324 million) was recorded, and this figure increased to 4,366 million in the following year. The war therefore strengthened the agitation for a single system. Unification followed the collapse when, by 1920, the railways were depleted and burdened. The Weimar constitution provided for the nationalization of the network and an amalgamation into a single system operated by the central government, though at first the financial predicament of the railways rendered their independence impossible. In 1920 the ratio of railway expenses to revenue was 122·8 : 100, and in the following year 108·5 : 100, but during the peak of inflation in 1923, it reached 330·9 : 100. The severance during the Ruhr occupation of one of the most remunerative parts of the network with the widespread dislocation of strikes, contributed seriously to the predicament. In November 1923, the combined system was re-organized into a commercially-managed unit independent of the government budget, as one of the pre-requisites for the stabilization of German currency.

Direct State Administration (1924–39)

As soon as the railways again became profitable after stabilization, however, they were implicated in the reparations problem under the Dawes Plan of 1924. In this year a new national railway reconstituted the system as an autonomous entity called *Deutsche Reichsbahn-Geselleschaft*, the essence of the scheme being to mortgage the railway network and to secure its earnings for the partial payment of reparations. In this way the railways became one of the principal sources of reparations to the allies, the annual payment being set at

£33,000,000. This arrangement, however, was superseded in 1930 by the Young Plan whereby foreign participation was abandoned, and before the National-Socialist government came into power the liberation of the railways was substantially accomplished, though they were still administered with a separate budget and financial autonomy.

From 1933 onwards the adjustments which went on were symbolized by the dropping of the word *Geselleschaft* in the title of the railway organization. In the following year the highly industrialized area of the Saar again passed under the control of the German Railways, and in 1937 Hitler informed the Reichstag 'that in the sense of the restoration of German equality the German railways . . . have been stripped of their previous character and have again been restored to the complete sovereignty of the Reich'. In the same year the government took over the rights of expropriation of those private companies still in existence which had previously been held by the state, and the Minister of Transport expressed the view that the state or Reichsbahn would take over the private railways gradually. The most important private systems affected were the Lübeck-Buchen railway (opened in 1881) and the Brunswick district railway.*

Successively, therefore, the last limitations on independence were brushed aside, and in 1937 the veteran Director-General, Dr. Dorpmüller was appointed to the new post of Minister of Transport with which were fused the duties of General Manager. Thus, without breaking a continuity of direction which long antedated the victory of National Socialism, the articulation of the railways in the political organization of the Reich was completed.

Classification of the Network

The railways of Germany consist mainly of the state-owned lines (nearly all standard gauge) together with a small mileage of privately-owned standard-gauge lines and the light railways, also privately-owned. Of the 33,878 miles of railway routes in the Reichsbahn system, 98·6% is of standard gauge, 4 ft. 8½ in., and the remainder 484 route-miles of 1·0 or 0·75 metre gauge. The standard gauge state-owned lines are classified either as main lines (*Hauptbahnen*) or as secondary lines (*Nebenbahnen*). The *Nebenbahnen*—15,626 route-miles in 1938 in Germany and Sudetenland—were technically

* The Lübeck—Buchen company owned 100 miles of line and employed 2,600 staff. The company had shown considerable enterprise in improving its passenger facilities in recent years. The Brunswick district company operated about 67 miles of track and employed about 650 staff.

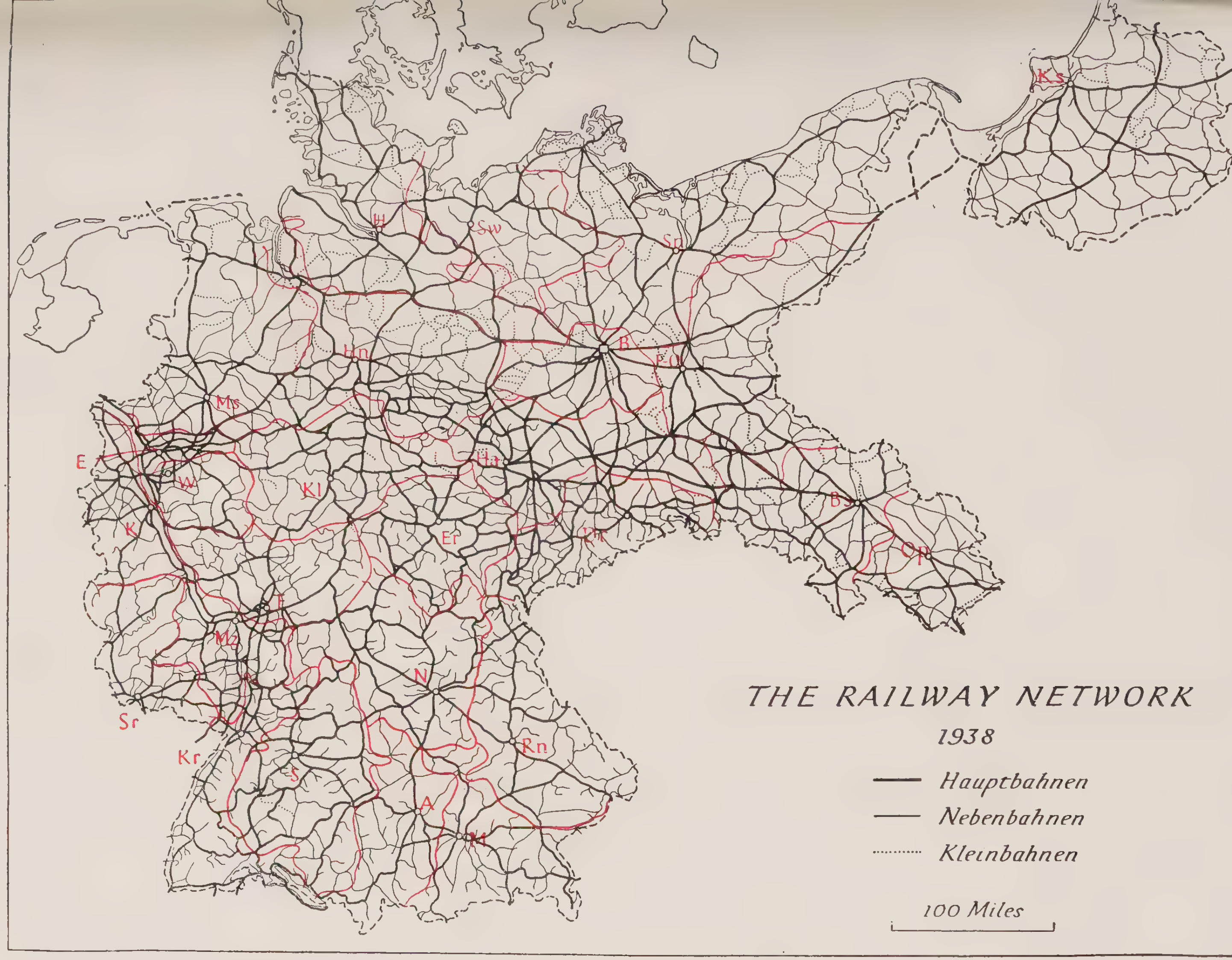


Fig. 48. The *Reichsbahndirektionen*

Based on a folding map in *Hundert Jahre Deutsche Eisenbahnen* (Berlin, 1935).

A Augsburg; B Berlin; Bs Breslau; Dr Dresden; E Essen; Er Erfurt; F Frankfurt-am-Main; F-O Frankfurt-an-der-Oder; H Hamburg; Ha Halle; Hn Hanover; K Köln; Kl Kassel; Kr Karlsruhe; Ks Königsberg; M Munich; Ms Münster; Mz Mainz; N Nuremberg; Op Oppeln; Rn Regensburg; S Stuttgart; Sn Stettin; Sr Saarbrücken; Sw Schwerin; W Wuppertal. Note: the boundaries shown are schematic, for simplicity of reproduction: there are no such boundaries in fact, as each R.B.D. is concerned with railways and not with areas of land.

of lower standard than the *Hauptbahnen*, but even so were often superior to main lines in south-eastern Europe. Of the restricted mileage of narrow-gauge track in the Reich the Reichsbahn owned 603 miles in 1940, distributed among the *Reichsbahndirektionen* (see p. 219, as follows (in miles):

R.B.D.	Dresden	336·0	R.B.D.	Karlsruhe	17·0
	Stuttgart	75·0		Schwerin	34·5
	Erfurt	46·5		Oldenburg	6·5
	Oppeln	39·0		Munich	3·1
	Ludwigshafen	37·3		Halle	0·2

(See Fig. 48 for location of R.B.D.)

The Reichsbahn narrow-gauge rails weigh 72 lbs. per yard, compared with 99 lbs. for the standard-gauge rail. A 72-lb. rail is adequate for a 16-ton axle load, which is the standard-gauge *Nebenbahn* level.

There were in 1938 still 2,796 miles of privately-owned line in Germany. When considered desirable a number of these lines, as in Sweden, have been nationalized. Most of these private lines are of only local importance.

Privately-owned Railways of 62 *miles* (100 *km.*) *and over* (1938)

Name of Railway	Length, miles	Location
Lübeck-Buchener Eisenbahn*	99·4	Schleswig Holstein-Hamburg
Brandenburgische Städtebahn	77·6	Brandenburg
Braunschweigische Landes-Eisenbahn*	67·0	Hanover-Brunswick
Hohenzollernische Landesbahn	66·5	Hohenzollern-Württemberg
Mecklenburgische Friedrich-Wilhelm Eisenbahn*	69·5	Brandenburg-Mecklenburg
Niederlausitzer Eisenbahn	70·0	Brandenburg-Saxony
Ruppiner Eisenbahn	132·5	Brandenburg
Teutoburger Wald Eisenbahn	62·1	Hanover
Westfälische Landes-Eisenbahn	164·6	Westphalia-Lippe
Mittelbadische Eisenbahn	70·7	Baden

* Nationalised 1938–41.

From official sources.

Light railways proper (*Nebenbahnähnliche Kleinbahnen*) had a route mileage of 5,841 in the Reich. Privately owned and operated, they were sometimes constructed with the aid of local authorities. These light railways were regarded as indispensable for the rural districts, particularly in the eastern provinces, where almost half of the narrow-gauge mileage is found. The advantages of these lines are the low building cost, amounting to only one-fifth of the cost of Reichsbahn track construction, and low running costs—one-ninth

of the cost of operating Reichsbahn lines. For these light railways to be operated economically, only four persons are required per kilometre, whereas the national lines need sixteen.

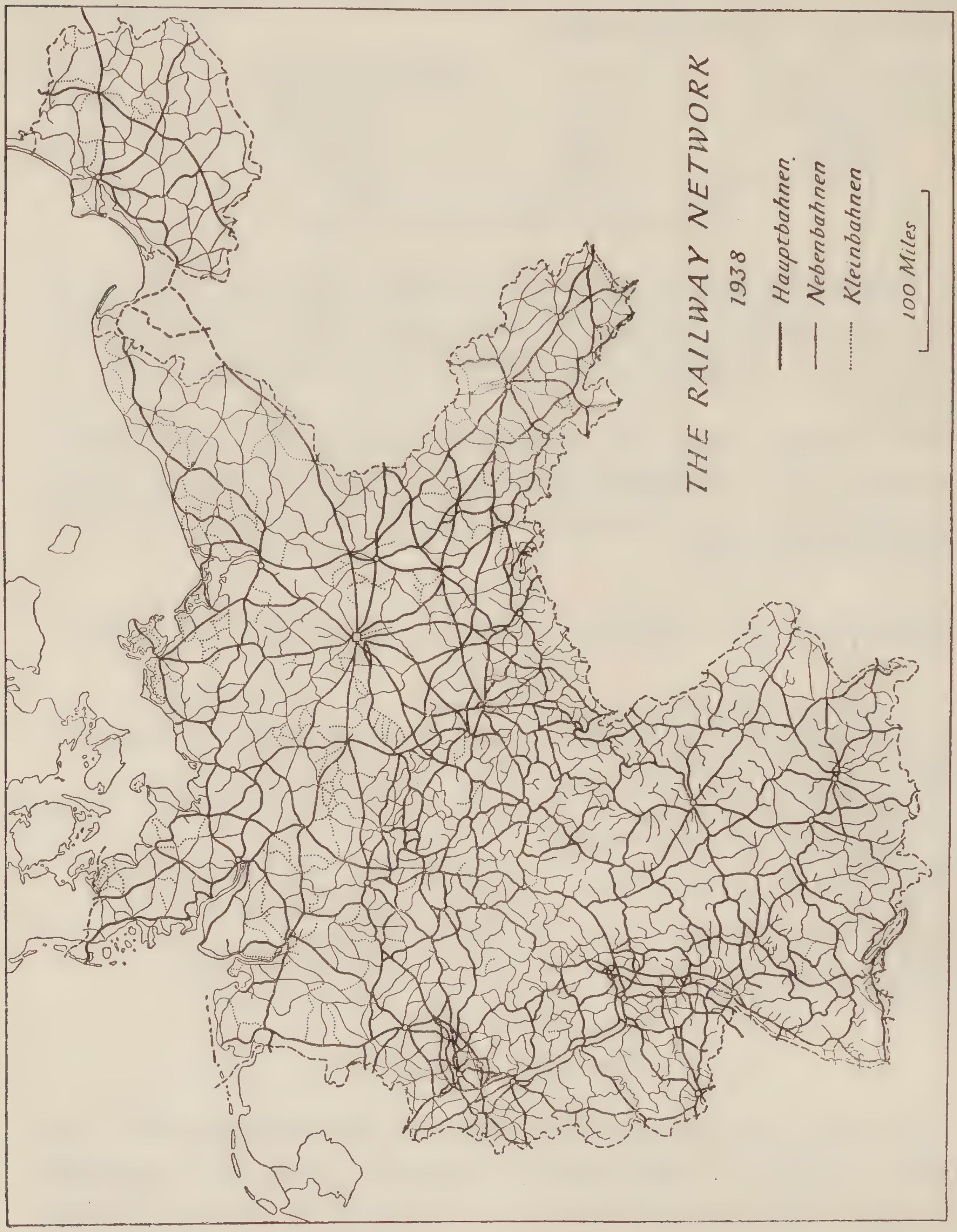


Fig. 49. The railway network
Based on official sources.

Administration

Organization

The Reichsbahn is a highly-organized and scientifically-operated industrial machine, built and worked to develop the state both

economically and strategically. Its status is laid down by the Reichsbahn Law of July 1939 which defined it as a state-owned undertaking enjoying a considerable measure of financial, administrative and operational autonomy.

The *Deutsche Reichsbahn* (German State Railway) controls the vast majority of the railway mileage in Germany. Since 1937 the offices of Minister of Transport and of General Manager have been merged in the same individual. This chief official acts on the one hand as general controller of all means of transport in the Reich, and, on the other, as full controller of the railways, and thus provides the government with a complete hold over the actual working of practically the whole railway system. He is advised by a committee formed both of industrialists and of government officials of ministerial rank.

Five departments, centralized in Berlin, control the management of the Reichsbahn in various aspects—traffic and rates, operating and civil engineering, mechanical engineering and purchasing, financial and legal affairs, personnel. Decentralization, so essential for the actual working of a great railway system, is attained by the divisions known as *Reichsbahndirektion* (R.B.D.), which are centred in important towns (Fig. 48). These divisions have autonomy in the local development and control of traffic. Within these divisions are districts concerned with the maintenance of track, rolling stock, operation of traffic, etc.

Personnel

The average number of personnel employed in 1936 was 659,943, slightly less than that on British railways, although the German track mileage was nearly half as long again. The percentage of staff in the various sections was:

Administration	7·0
Railway maintenance	12·6
Line inspection	4·6
Operating	34·1
Train crews	6·8
Locomotive crews	10·5
Main repair shops	13·5
Running depots and technical	10·8
Marine activities	0·1

From official sources.

Of the operating expenses about 60% is accounted for by salaries and wages. According to British standards German trains are overstaffed, a position which arises from the fact that the Reichsbahn has

pursued a policy of getting more work out of travelling men and so achieving a reduction in station staffs.

The standard of technical training is high, but since 1939 the necessity of operating railways in occupied countries has required replacement by the drafting in of less skilled staff.

In 1929 the Reichsbahn was forced to make severe economies in staffing and the number employed fell from 713,119 in 1929 to 643,750 in 1931. The saving of salaries was appreciable, i.e. 3,000 million marks, or about 14%. The following year saw a further falling off of traffic and the staff was reduced by a further 40,000.

Working conditions are controlled by the state. In 1923 the 8-hour day was established as standard, but prolongation up to 10 hours was permitted. For the majority of workers the hours of work are fixed either by the staff regulations, or by agreements, and the weekly working time varies from 48 to 60 hours. The average (pre-1939) working time for locomotive crews amounts to 54 hours. The personnel has 52 rest days per annum, a rest day being defined as 32 hours free of duty. Leave varies with age and status, e.g. engine drivers have 17 to 31 days leave a year. Leave of absence for attendance on *Reichstag* or *Landtag* duties is not counted against leave.

Compulsory old age and accident insurance was established in 1889 and the Reichsbahn has its own fund for the care of sick employees.

Financial Position

Generally speaking, the Reichsbahn has been in a fair financial condition since the end of the inflation period in 1924. The succeeding five years were prosperous, but the following depression was only met by drastic control of expenditure. The long-continued deficit during the years 1929–1932 was due to the economic crisis which affected every branch of German industry, to heavy fixed charges amounting to 70% of the general operating expenses, to the abuse of special rates, to rash investments, and to the competition of motor transport. From 1933, during the period of recovery from the economic depression and preparation for war, the financial position steadily improved.

Capital charges on the Reichsbahn are relatively small since funded debts of the former state railways (see p. 212) were nullified by the inflation. The reparation obligations of 1924 were virtually eliminated after 1931. By a law of 1937, a percentage of the revenue is paid to the government for use of state property, but all fixed

charges only amounted to 5·2% of the revenue. Since 1939, the Reichsbahn, unable to spend its surplus revenue, has accumulated vast capital reserves.

Railway Obligations for Conveyance

The constitution makes a distinction between the main and secondary lines of the railway system, both of which are supervised by the Ministry of Transport. The railways of general value, after being authorized by the state, must be constructed and equipped to standards established by the state. They must accept all traffic offered under normal conditions of transport. Goods must be conveyed in the order in which they are received, unless special arrangements have been made. The railways are responsible for accidents due to their fault and to damage and loss due to delays. The rates must be applied uniformly to all users, except in certain specified cases, and must be approved by the public authorities, who have the right to modify them. If there is any difference of opinion about rates, the Railway Tribunal arbitrates between the Reichsbahn and the Government. The railways collect the tax levied by the state on passenger and goods transport. They are under an obligation to supply the customs authorities with premises for inspection of goods and to transport soldiers at reduced rates. Since 1924 the Post Office has had to pay for the use of railway facilities; previously these services had not been chargeable.

The private railways have similar rights as the Reichsbahn, viz. protection against road competition, and while the state does not guarantee interest payment there is legal authority for charging rates calculated to give an adequate return on capital. During the economic depression, in order to aid the railways in their struggle to reduce their deficit, there was remission of taxation, but the government never went so far as to suppress the transport tax as was done in Great Britain with the passenger tax.

The Permanent Way

Lay-out

A feature of the Reichsbahn is the spaciousness of the lay-out and of the attendant facilities, particularly passenger stations, goods depots and marshalling yards. The large number of burrowing and fly-over junctions greatly eases traffic movement. There is a considerable mileage of double and multiple track. The percentage of the

total length of track taken up by double and multiple track is intermediate between that of countries in eastern and countries in western Europe. The track mileage percentage accounted for by the considerable number of sidings and marshalling yards emphasizes the intensity of industrial activities in parts of Germany, for in the north there are wide tracts of lakes, marshes and infertile sands, and in the south there are extensive mountain regions.

Percentage relations to total route mileage

	Double and multiple route mileage	Track mileage
Belgium	58·3	274
Netherlands	50·8	214
France	47·2	196
Germany	35·3	225
Poland	21·1	200
Bohemia and Moravia	19·3	171
Slovakia	15·0	130
Denmark	12·2	114
Baltic States	3·0	144

From official sources.

In Great Britain the approximate percentage for double and multiple route mileage is 65.

The whole of Germany, as well as western and central Europe, as far as and including western Poland, Bohemia and Austria, have a close railway network, so that every settlement of any size is within 10 miles of a railway, whilst east of this area considerable areas lie at a greater distance from a railway.

Track

The former diverse types of track were eventually standardized with Vignoles flat-bottomed rail (99 lbs. per yard). In recent years welded rails up to 196 ft. in length have been laid. Trunk lines are mainly laid with sleepers of hardwood (oak or beech) and softwood (pine or fir), which provide a more elastic track than the steel sleepers widely used at one time. Steel sleepers are useless in some industrial areas owing to the effects of corrosion by fumes. Various kinds of ballast are used, but the standard is broken slag or hard broken stone; basalt is considered the most satisfactory, and limestone the least.

Despite alleged deficiencies, the standard of maintenance on the German railways in 1939 was high. While only about 621·4 miles of track were renewed in 1938 compared with over four times this length in 1926, it must be remembered that the high mileage of renewals during the twenties was accounted for by the heavy programme necessary to overtake arrears of maintenance resulting from

the war of 1914–1918. Advantage was then taken of this necessity to adopt improved standards of construction. In 1937, over 400,000 tons of steel were used for track relaying, of which one-third was used for rail replacement: in other words, the track as a whole was being far from neglected. 'Spot' (i.e. *ad hoc*) rail renewals, furthermore, had greatly increased before 1939. The work of relaying track is carried out normally by the engineering department of the Reichsbahn.

Axle-loads

So far as railway locomotives and rolling stock are concerned, the maximum axle-load permitted is 20 tons. The usual track maximum on the main lines is 20 tons, although there are some main-line sections with permissible axle-loads of only 16 tons. On secondary lines the normal maximum is 16 to 18 tons, but may be considerably lower. On private lines the maximum is usually the same as on the Reichsbahn secondary lines, but some of these private railways, such as the Köln-Bonn line, are constructed for a 20-ton axle-load. New bridges are often built to permit an axle-load over 20 tons, but until a long section has been improved in this way it is the practice not to allow locomotives to be built to exceed the standard axle-load.

Gradients

For new construction gradients outside stations must not exceed 1 in 40 ($25^{0}/_{00}$) on main lines and 1 in 25 ($40^{0}/_{00}$) on secondary lines, although 1 in 15 is found in at least one section. Generally speaking, the Reichsbahn track is well graded. The physical background of the country results in a well-marked distribution of the more severe gradients in the centre and south. The elevated regions and the south are deeply penetrated by the valleys of considerable rivers, such as the Rhine, Main and Neckar, which provide convenient routes for the lines bearing the heaviest traffic.

Gradient statistics, 1937

	Route length in miles	Percentage of total route length
Level sections	2,480	28·3
Graded sections	9,590	71·7
Gradients up to 1 in 200		40·2
Gradients 1 in 200 to 1 in 100		19·3
Gradients 1 in 100 to 1 in 40		11·6
Gradients over 1 in 40		0·6

From official sources.

The mountainous nature of many districts in the south-west results in steep gradients, even on main lines—between Bad Reichenhall and Berchtesgaden, for example, there is a gradient of 1 in 25. In addition

Fig. 50. Heavily graded lines in the hilly and mountainous districts of south and central Germany

Based on Wiener, L., 'Note on Train Speeds', *Bulletin of the International Railway Congress Association*, vol. 19, p. 1717 (Brussels, 1937).

The thick lines show the lines with the heavier gradients, and on some of these rack working is necessary. The asterisk indicates the Höllental railway in the Black Forest. B Bamberg; Kl Kassel; Kr Karlsruhe; Mg Magdeburg; N Nuremberg; Pr Probstzella; Wz Würzburg.

there are local lines where considerable detours have been made to avoid steep gradients, e.g. between Weizen and Blumberg on the *Nebenbahn* from Waldshut to Immendingen (Fig. 84). It is only 10 km. (6·2 miles) between these points, yet the railway runs for

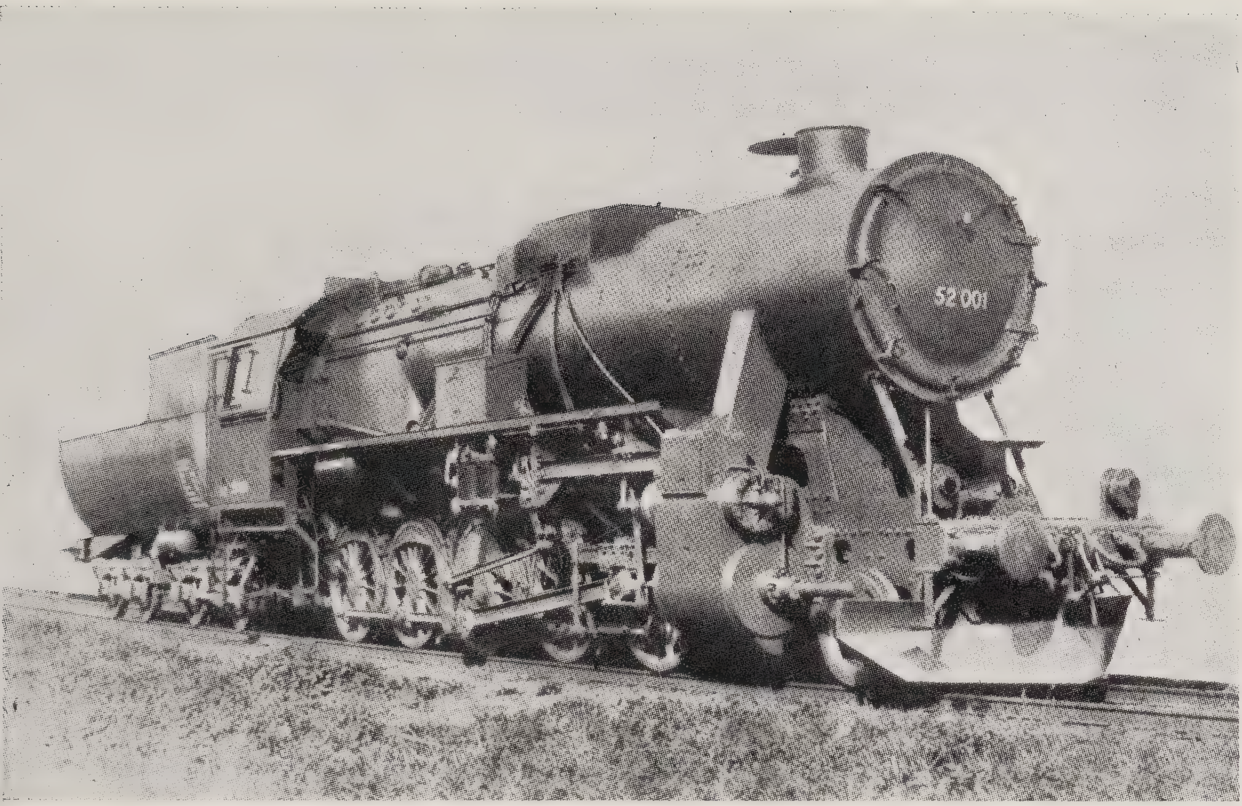


Plate 45. *Kriegslokomotive*, 52 class
The German 'war austerity' locomotive.

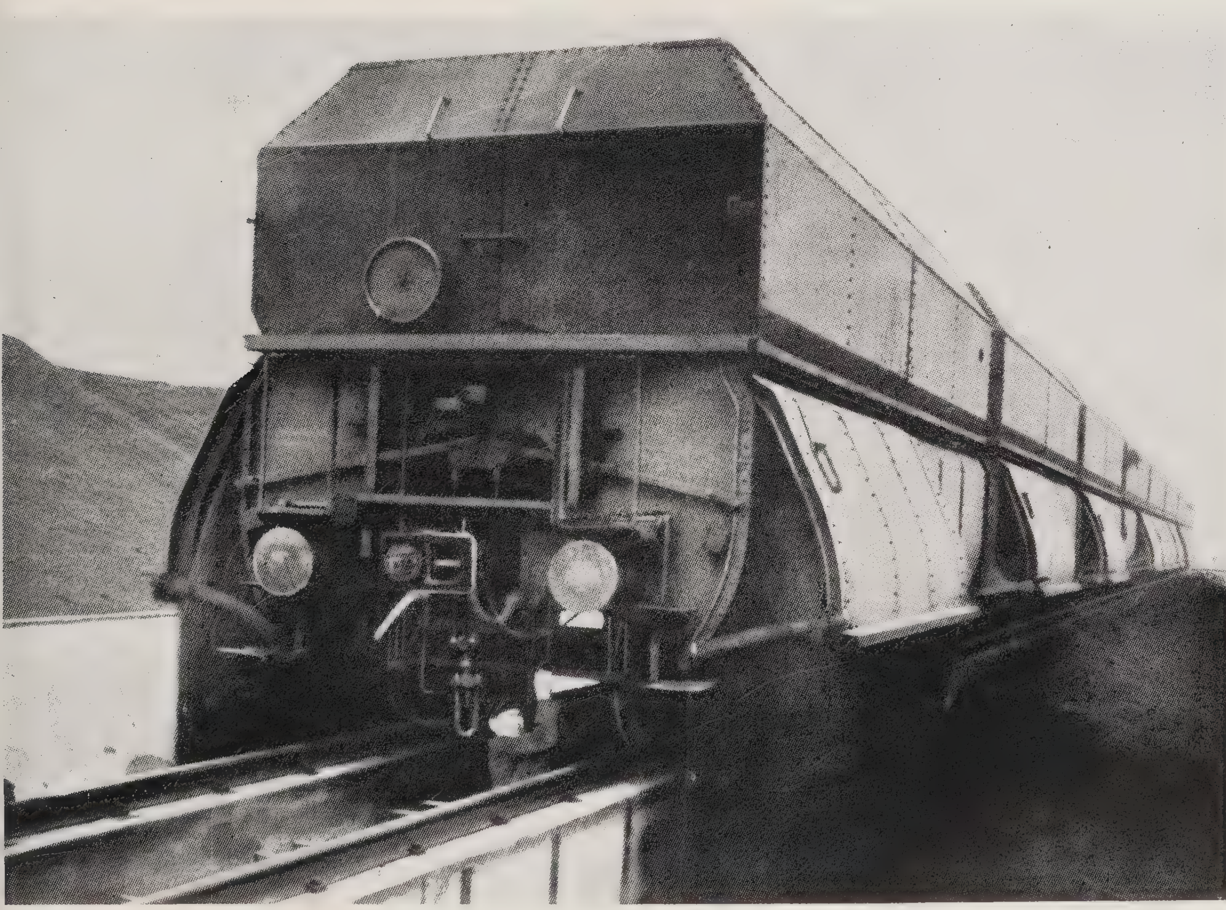


Plate 46. Unloading a coal train, Berlin-Rummelsburg
Near the Rummelsburg marshalling yard lies the Klingenberg power station (Plate 123). For details of the type of wagon shown, see p. 235.

Plate 47. A heavy goods train crossing the Mosel near Eller

The wagons are laden with coke. Near Eller is one of three bridges between Koblenz and Trier, roughly halfway between the two towns. The bridge lies at the south end of the Cochem (Kaiser-Wilhelm) tunnel, the longest in Germany. The tunnel enables the line to avoid following a wide eastward meander of the deeply incised Mosel.

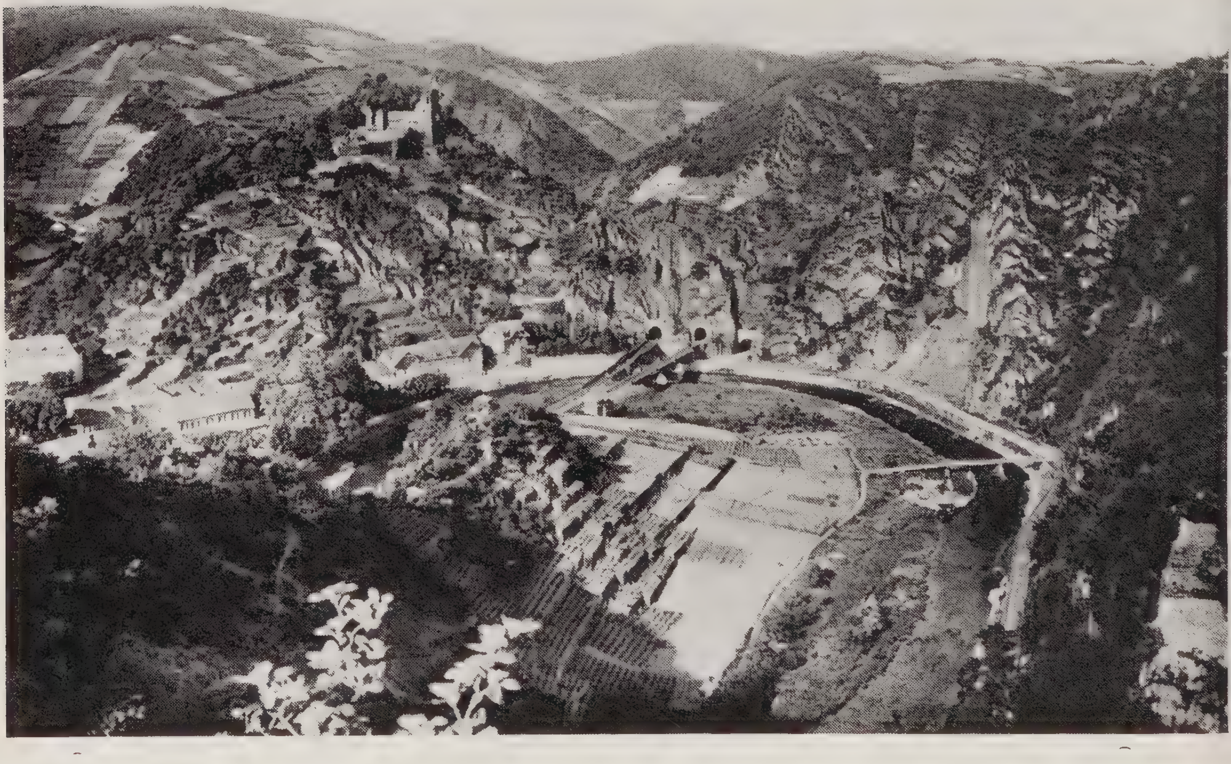


Plate 48. Altenahr: the three tunnels, looking north-east

The Ahr flows across the northern slopes of the Eifel to enter the Rhine at Linz, south of Bonn. At Altenahr a meander about 2,500 yds. in circumference is only about 200 yds. across the neck. The double-track railway from Remagen to Gerolstein pierces the neck by two tunnels and the road by a third. Where possible the steep slopes of these slaty lower Devonian rocks are terraced for vineyards.

25·5 km. (15·8 miles) to make good a difference in altitude of 758 feet. In the Black Forest, in spite of gradients of 1 in 50, it is necessary for the Black Forest Railway to cross the central ridge by a double spiral and a helical tunnel between Hornberg and Nussbach in order to rise 984 feet. An account of mountain railways will be found on pp. 271–4, and gradients on a great many main lines are described in the sections of this chapter forming the 'Geographical Description'.

Curvature

Curvature of track is now controlled with the following minima: main line, 590 ft. radius, and secondary, 328 ft. Modern main-line rolling stock is built to take curves of 492 ft. radius.

Curvature statistics, 1937

	Route length in miles	Percentage of total route length
Straight sections	23,022	68·0
Curved sections	10,855	32·0
Curves of radius 1,640 ft. and over		21·3
Curves of radius under 1,640 ft.		10·7

From official sources.

Engineering Works

Bridges

The great waterway of the Rhine is crossed by twenty-two railway bridges between the Swiss and Dutch frontiers (Fig. 51). These bridges vary from single-track structures in the upper course, where railway traffic is less intense, to the great Hohenzollern (Köln-Deutz) bridge which carries four railway tracks, besides a tramway and a road. The navigation authorities for the Rhine have laid down that the navigation span of the bridges is to be 492 ft. to 623 ft., according to the angle between the bridge and the fairway. The Elbe and the Oder bridges also are frequently structures of considerable magnitude (Fig. 51). The most spectacular railway bridge in Germany is that carrying two tracks across the river Wupper near Müngsten. The deeply incised valley necessitated the construction of the loftiest trussed bridge in the world with a clear span of 525 ft. at a height of 350 ft. above the stream. The Rendsburg and Hochdonn bridges over the Kiel C. are also spectacular structures.

Fig. 51. Railway bridges with a length of about 300 ft. or more

Based on official sources.

The location, structure and other details of these bridges are described in the tables on pp. 300, 314, 328, 341, 355, 378, 395, 404, where each bridge is numbered according to the numbers on the map. The large bridges are associated mainly with the great rivers or with the areas of high relief.

Tunnels

Lengthy tunnels have not been so necessary on the German railways as on those of Austria. As with the bridges, most of the longest are found in western Germany, where traffic is heavy and the relief most accidented. In the Federal state of Baden there are no fewer than 113 railway tunnels, of which five are over 1,093·6 yards long, In the whole country there are seven tunnels over 2,000 yards long:

Kaiser Wilhelm (Trier–Koblenz)	4,648 yds.
Distelbrasen (Hanau–Bebra)	3,828
Grossherzog-Friedrich (Fahrman)	3,467
Krahberg (Odenwald)	3,318
Brandleite (Thuringia)	3,242
Rudersdorf (Giessen–Hagen)	2,893
Königsstuhl (Heidelberg)	2,727

From official sources.

Stations

The German civic authorities, unlike those in Great Britain, assisted the railways to provide adequate main stations, which were regarded as the principal entrances to the cities, by donating land to provide impressive frontages with adequate open spaces. The Central Station at Frankfurt-am-Main, for example, was the finest terminus in Europe at its opening in 1888, but the Leipzig station now takes pride of place, although it is rivalled by those of several other cities, such as Königsberg. The station lay-outs are largely standardized, with roomy concourses. The platforms of the main stations are about half the height of British platforms.

Locomotives

Locomotive Types

In 1937, before the incorporation of the Austrian Federal Railways, the locomotive stock comprised 20,709 engines, of which fewer than 250 were for narrow-gauge operation.

There were also a few steam locomotives of an experimental type.

Types of Locomotives, 1937

Coupled axles	Steam		Electric
	With tenders	Tank	
2	8	184	97
3	4,513	3,742	
4	4,186	3,216	361
5	3,518	1,622	0
6	44	11	85
8	0	22	0
Total	12,269	7,897	543

From official sources.

The steam locomotive stock comprises two main groups: first, those of the former state lines (Prussian State Railway, Bavarian State Railway, etc.), and secondly, standard types built since the formation of the Reichsbahn, as well as post-1939 types designed to accelerate locomotive production, and to use economically the available materials. The most powerful German engines are all of recent construction, for after the war of 1914–1918 Germany was compelled to hand over 9,400 locomotives to the Allies; most of these were nearly worn out after four war years without proper repair. The German

designers spent a few years thoroughly trying out new prototypes and then built a range of modern three-, four-, and five-coupled axles which were at the time of building the last word in design. As a result of this large-scale post-war replacement the average age of the Reichsbahn locomotive stock was only 18·9 years in 1937. A concomitant advantage was the reduction from 270 classes of locomotive in 1920 to about 100 classes in 1937. In the latter year there were only 24 classes being built, and even with these there were many interchangeable parts.

The German engines tend to be heavy with an average weight, excluding tenders, of 81·8 tons. They stand about 15 ft. high, that is, some 2 ft. more than the average British locomotive, but appear relatively even taller to an observer on a station platform only a few inches high. The youthfulness and relative heaviness of German locomotives provides an interesting commentary on the railway history and operation when compared with other countries:

Age and Weight of Locomotives, 1937

	Average age, years	Average weight, tons
Germany	18·9	81·8
Belgium	28·7	58·1
Netherlands	25·3	?
Denmark	25·3	40·0
Greece	40·0	75·5

Special locomotive types. There are some interesting special types of engine in Germany. The first six-coupled axles were introduced on the Württemberg State Railway, and this section of the Reichsbahn now has thirty-three 2–12–0 4-cylinder compounds to cope with heavy traffic on severe gradients. The considerable number of five-coupled axle engines work over secondary routes as well as on main lines. On the Halberstadt—Blankenberg railway, which climbs up to the Harz mountains with gradients up to 1 in 16, monster 2–10–2 tanks handle the goods trains. This line is so hard to work that these 110-ton engines can barely pull uphill a load of 130 tons at a speed of 10 m.p.h. Short-distance express trains are handled by 4–6–0 tender and 4–6–4 tank locomotives. For the express work from Berlin to Hamburg (178·2 miles in 149 minutes), specially designed streamlined 4–6–4 locomotives were built with driving wheels no less than 7 ft. 6½ ins. in diameter: at the trials in 1936 a speed of 124·5 m.p.h. was recorded. These locomotives appear as class 05 in the table on p. 230.

Locomotive Classification

The classification letters and numbers of German locomotives are fully coded. All engines bear a letter to show the type of service for which they are intended:

S	Express train	*Schnellzüge*
P	Slow passenger train, tender	*Personenzüge*
Pt	Slow passenger train, tank	*Personenzüge*
G	Goods train, tender	*Güterzüge*
Gt	Goods train, tank	*Güterzüge*
Z	Cog wheels	*Zahnrad*
L	Local line	*Lokalbahn*
K	Narrow gauge	*Kleinbahn*
E	Electric	*Elektrische Lok.*

Each locomotive also bears a series number and a number indicating its place in the series, e.g. 03·124 is in the 03 series (express tender engine) and the engine is the 124th of that series. An older system of numbering also used has an operating number which reveals class, number of coupled axles, total number of axles and average axle-load in tons.

The two systems are correlated in the table on next page, where in the second column the letters are as above, the first digit the number of coupled axles and the second the total axles; after the first full point the figures represent the average axle-load in tons. The wheel arrangement is indicated by the number of axles (shown by letters and figures), e.g. a 4–6–2 is a 2C1 and a 2–8–0 is 1D in German notation, but in the third column of the table British convention is followed.

The Reichsbahn locomotive stock declined in numbers during the period from 1929 to 1937, but the effective locomotive power did not fall so severely, as fewer engines were laid up for repairs.

	1929	1937
Steam locomotives		
Available for service	19,325	17,375
Under repair	4,373	2,791
Electric locomotives	388	543

From official sources.

The increase in the number of electric locomotives is significant, for they replaced a greater number of less powerful steam units. The above figures take no account of the 700 high-speed diesel-electric and other railcars, or the 1,200 shunting tractors.

Locomotive Classification

	Series	Code	Wheel arrangement	No. of cylinders
Express locomotives	01	S.36.20	4–6–2	2
	01^{10}	S.36.20	4–6–2	3
	02	S.36.20	4–6–2	4
	03	S.36.17	4–6–2	2
	03^{10}	S.36.18	4–6–2	3
	05	S.36.19	4–6–4	3
	06*	S.48.20/18	4–8–4	3
Ordinary passenger locomotives	24	P.34.15	2–6–0	2
	24	P.34.15	2–6–0	2
Goods train locomotives	41*	G.46.20/18	2–8–2	2
	43	G.56.20	2–10–0	2
	44	G.56.20	2–10–0	3
	44	G.56.20	2–10–0	4
	45*	G.57 20/18	2–10–2	3
	50	G.56.15	2–10–0	2
Passenger tank locomotives	61	St.37.18	4–6–4	2
	62	Pt.37.20	4–6–4	2
	64	Pt.35.15	2–6–2	2
	71^{0}	Pt.24.15	2–4–2	2
Goods tank locomotives	80	Gt.33.17	0–6–0	2
	81	Gt.44.17	0–8–0	2
	84	Gt.57.18	2–10–2	3
	84	Gt.58.18	2–10–2	2
	85	Gt.57.20	2–10–2	3
	86	Gt.46.15	2–8–2	2
	87	Gt.55.17	0–10–0	2
	89N	Gt.33.15	0–6–0	2
	89H	Gt.33.15	0–6–0	2
Narrow-gauge locomotives	92^{22}	K.57.10	2–10–2	2
	99^{32}	K.46.8	2–8–2	2
	99^{73}	K.57.9	2–10–2	2

* Load on coupled axle 18 or 20 tons at choice. N = saturated steam used; H = superheated steam. 'L' services (p. 229) are operated by locomotives of the second, third, fourth and fifth groups.

From: *The Railway Gazette*, vol. 79, pp. 206–8 (London, 1943).

German engineers have made important experiments in the use of very high boiler pressures with over 1,000 lbs. per square inch in at least one case. They have also experimented with turbine locomotives on the principle of the Swedish Ljungström turbine engine with the 8,000 R.P.M. of the turbine reduced by gear. The highest speed ever known on rails was achieved in 1931 by an experimental coach driven by a propeller on the Berlin to Hamburg run, when an average speed of 95·7 m.p.h., and a maximum speed of 143 m.p.h. was attained.

Locomotive Maintenance

Longer engine workings with more efficient rostering and im-

proved running-shed maintenance resulted in an increase of the distance run between main overhauls from 72,000 miles per locomotive in 1932 to 80,780 miles in 1938. The result was an increase in the steam locomotive mileage from 594·3 million miles in 1929 to 677·3 million miles in 1938, despite the considerable decrease in the locomotive stud.

Generally it may be said that at important operating centres, several separate engine sheds are preferred to a concentrated running depot; e.g. in Köln there are six separate depots. The usual type is the roundhouse: rectangular sheds are found as a rule only at the largest centres. These sheds are equipped with workshops for ordinary locomotive running repairs. In addition to the running repair shops there are major repair shops. Since 1918 the equipment of both has been improved and general overhaul is done by the assembly-line method. Limitation of types and standardization of parts has aided the adoption of this method. The location of the major workshops is shown in Figs. 68, 71, 78, 80, 83, 89, 95, 97, 98.

Repair shops, for rolling stock as well as for locomotives, are spread over a great number of relatively small shops: in Great Britain, on the other hand, the work is concentrated in a few very large shops. This policy of decentralization has proved an advantage in repairing air-raid damage.

Locomotive Fuel and Water Supply

The coal consumption of the whole system was 14·46 million tons in 1936, of which 88% was used in locomotives, representing a consumption of 22·2 tons per 1,000 engine miles. Most of the coal comes from the central Ruhr area after inspection by a railway Coal Department with headquarters at Essen ; a considerable amount is also taken normally from the Silesian field. But the best Ruhr steam coal used for locomotives has a calorific value of only 6,400–7,200 units per kilogram compared with 8,600 units for the best British steam locomotive coals. About 15% of the coal used for railways is in the form of briquettes made from slack. Railway coal is received and inspected by regional offices (*Kohlen-abnahmeamt*), which are responsible to a central Berlin office. To Germany belongs the credit of having built the first locomotives fired with powdered fuel. Locomotives burning this type of fuel carry on the tender a closed container for the finely ground coal-dust which, together with a suitable quantity of air, is blown into the firebox, where it burns with the same kind of flame as with gas or oil fuel but leaves a residue of finely divided dust.

In 1937 the Reichbahn used 38,000 tons of heavy oil for diesel engine fuel.

Locomotive water supply. Water supply for railway purposes is generally satisfactory throughout Germany; about half the installations are mechanically operated. Water-troughs between the rails, as used in Great Britain, are not employed. Chemical water-softening is carried out where necessary.

Other Rolling Stock

Passenger Train Stock

The number of vehicles at the end of 1937 was as follows:

	No.
Passenger carriages:	
with 2 axles	18,809
,, 3 ,,	30,586
,, 4 ,,	14,896
,, 6 ,,	198
Total	64,489*
Luggage and parcels vans	19,983*

From official sources.

* Includes about 1% narrow-gauge vehicles.

As with the locomotive stock, there has been a considerable amount of standardization. For general purposes 2nd and 3rd class have served the needs of Germany since the elimination in 1928 of the 4th class, and of the 1st class from all except international and FD trains. In this year the introduction of the *Rheingold* express marked the adoption of the Pullman type of saloon coach. Passenger stock on fast trains is normally of steel construction; the 1st and 2nd classes have upholstered seats, while the 3rd class has wooden seats. Stock used on the stopping trains is generally of old type, whereas the stock employed on semi-fast or express work is generally of modern bogie pattern comparable with the best in Europe. The fleet of high-speed diesel-electric coaches set a yet higher standard of passenger comfort, and telephone and wireless facilities were also introduced. In 1937, largely owing to post-1919 replacements, the average age of the German coaches was only 20·6 years. In addition to the Reichsbahn coaching stock 344 sleeping-cars and 321 dining-cars belonging to the *Mitropa* company normally operate over German lines.

Goods Train Stock

The number of vehicles at the end of 1937 was as follows:

Covered	190,811*
Open	346,303*
Special	37,885*
Private	41,186

* About 1% narrow-gauge vehicles.

From official sources.

This number, including privately owned, averaged 10·6 per km. The wagon position resembles the locomotive position in falling from 660,758 wagons in 1929 to 574,999 in 1937, owing to the withdrawal of a large number of old vehicles of small capacity and their replacement by a smaller number of higher capacity, built to standardized designs. In 1919 the railways were forced to hand over 280,000 wagons to the Allies: this removal of pre-1914 stock and consequent replacement of old wagons resulted in the average age of German goods vehicles falling to 22·2 years in 1937. This average age would have been considerably lower if there had not been a cessation of new construction during the years of economic depression (1929–32). The average capacity of the goods vehicles in 1937–8 was 18·6 short tons.

Apart from some 12,000 bogie flat trucks, most wagons are of the four-wheel type. Most goods stock is now fitted with Kunze-Knorr * automatic compressed-air continuous brakes and so can be assembled with passenger stock for fast running and used with vehicles fitted with the Westinghouse brake. Before 1939 the Reichsbahn had about 13,000 'convertible' wagons for use in connexion with U.S.S.R. traffic: these wagons had interchangeable axles. The stock also included vehicles conforming to the British loading gauge for use on the Harwich ferry service.

Privately-owned stock includes all tank wagons, and so these do not appear in the official returns. A curiosity of railway rolling stock is the fish tank wagons of a Dresden firm used for carrying live fish from Altona to the markets of central Germany.

Special coal wagons. The importance of the coal, coke and lignite traffic is clear from the fact that it provides 40% of the total revenue tonnage carried by the Reichsbahn. The standard wagon used for coal traffic is a 20-tonner, with a tare weight of about 10·5 tons. These wagons are constructed with a steel underframe and wooden

* Or Hildebrand-Knorr.

sides, and are equipped with end-doors and two side-doors usually of steel. They are of the high-sided type and can be loaded at practically every mine. Other wagons of 15 tons capacity are sometimes used for coal-loading, but such use is rare except in times of wagon shortage.

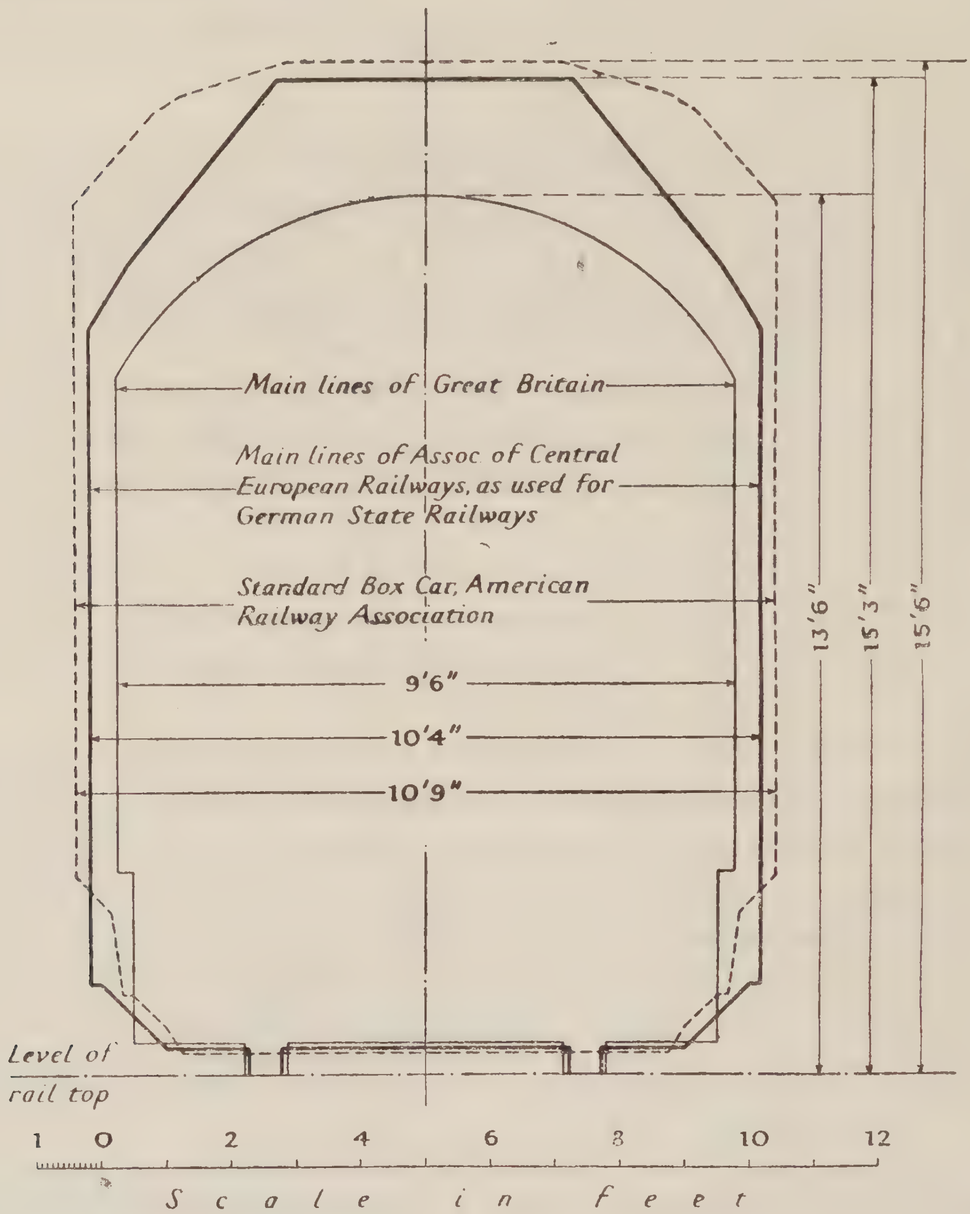


Fig. 52. Clearance diagram for German, British and American rolling stock
Based on official sources.

The diagram shows clearly the greater loading capacity of German compared with British rolling stock: the German, in fact, nearly reaches the American standard.

For certain regular coal movements, however, e.g. from Silesia to the Berlin power stations, high-capacity wagons of a very remarkable design, embodying, among other features, specially designed bearings, are employed. These eight-wheeled, non-bogie wagons are of

side-hopper design and carry 60 tons. They are equipped with a special type of coupling and are run in set trains. One man is able to discharge a wagon in two minutes. The turn-round of these shuttle trains, which have a gross load of 1,700 tons, is notable as they average 315 miles per working day—nine times the daily mileage of the average German wagon. The design of the L.M.S.R. high-capacity wagons which feed the Stonebridge Park Power Station was based on this special type.

The few privately-owned wagons used for coal traffic are restricted to the private railways such as Thyssen's line serving the coal shipment port of Ruhrort; in this case kibble-wagons have been used extensively. These are containers holding coal which are loaded on to bogie flats; at the shipment port they are lifted by cranes and discharge the coal into barges through bottom doors. The 20-tonner high-sided wagon is also used for timber, ore, etc. Since there is an entire common-user system, many of these wagons work back to the mining centres carrying return loads. Approximately half of the coal wagons loaded weekly, apart from the Saar field, are loaded in the Ruhr, where the ratio of load carried to wagon capacity is very high —19 tons per wagon. A 20-ton wagon fully loaded gives an axle load of 15–16 tons, and as this is the maximum allowed over most of the secondary lines in the country, the standard size of wagon is not likely to increase for many years,* otherwise universal availability would suffer. It is largely owing to the work of the Central and District Wagon Distributing Offices that the case of a mine being stopped for lack of wagons is practically unknown, but the advantages of a standardized wagon supply of about 300,000 units, capable of being used for the conveyance of coal, together with single ownership and strict penalties with regard to undue delay for unloading, must greatly assist the achievement of this excellent result.

Examples of coal rates for January 1935 show that German rates were low, but not the lowest:

	Coal rate per ton (Belgian francs)	
Country	100 km.	200 km.
Belgium	26·80	33·70
France	57·72	86·09
Germany	48·80	80·90
Netherlands	52·41	78·62
Italy	52·20	82·44

From: *Report of the Board of the Belgian National Railways*, 1935.

* Assuming, of course, that no new bogie designs are introduced.

Locomotive and Rolling Stock Manufacture

The German railways have never undertaken the construction of new equipment and, relying on the outside manufacturers, have helped the export trade by giving a relatively regular flow of orders, so reducing overhead costing. When German locomotive builders are quoting other European countries for the supply of railway engines they often put forward designs similar to the Reichsbahn standard locomotives so that they can use patterns and drawings already existing. This is a long-standing practice: before 1914 some of the Prussian 4–6–0 locomotives were so frequently copied by exporters that the type was more a European standard engine than a German one. During the economic depression of 1929–32 there were few orders for new construction, and by 1934 the condition of the stock was so serious that new construction had to recommence.

In the spring of 1939 the Reichsbahn announced a four-year plan for new equipment, including 6,000 locomotives, 10,000 passenger coaches and 112,000 goods wagons.

The principal builders of main-line locomotives are:

Henschel und Sohn, Kassel Friedrich Krupp, Essen Berliner Maschinenbau, Berlin Borsig Lokomotivewerke, Hennigsdorf, near Berlin	Capacity of each about 100–250 locomotives per year.

Other centres producing some locomotives are Hanover, Allach, Jungenthal-bei-Kirchen, Drewitz-Potsdam, Elbing, Esslingen, Munich and Köln.

Other rolling stock is made by some of the above firms, but the bulk of the production of wagons and coaches is in the hands of specialist companies. The largest of these is *Linke-Hofmann-Werke A.G.* (Breslau) which, with the best-equipped German rolling stock workshop, makes up to 11,000 wagons a year. The wagon builders are now largely organized into trusts: the eastern trust received 26·77% of the Reichsbahn orders, the western trust 20·32%, and the central trust 9·50%. The remaining orders go to independent firms, the most important of which are *Waggon u. Maschinenfabrik*, Görlitz, and *M.A.N.*

Electrification

Germany has not electrified a great percentage of her railway mileage, partly for military reasons and partly on account of the adequacy of

her coal supplies. With only about 4% electrified Germany compares unfavourably with France (6·8%), Norway (11·4%), Austria (12·9%), Netherlands (15%), Italy (32%) and Switzerland (77%). In 1937 the following lengths of line were electrified:

	Miles	Km.
Single track	373	599
Double track	1,018	1,639
Multiple track	16	25
Total route length	1,407	2,263

The process of electrification began before 1914 in Germany on a few minor lines in Bavaria and Baden. After 1918 it spread rapidly, particularly in the years preceding 1939, despite objections by the military authorities. In central Germany the Magdeburg—Bitterfeld—Leipzig lines and those in the mountains of Silesia were electrified in the twenties, and those of Bavaria in the thirties. The electrified system of south Germany reaches Stuttgart in the west and Salzburg (Austria) in the east and covers all lines south of Munich as well as the line to Kufstein on the Austrian border. The two main lines north of Augsburg and Munich were electrified to Weissenfels, 18·6 miles south of Halle, but this fails to connect with the central German electrified lines. (This connexion was in hand for electrification during war-time.) In general, the areas difficult for traffic operation and remote from suitable coal resources have been electrified first. Both the Bavarian and Berlin electrification saved the haulage of Ruhr coal over distances of 400 miles. Hamburg and Munich have had their urban and suburban lines electrified.

The extent of electrification may be summarized as follows:

	km.	miles
Silesia (Görlitz–Breslau area)	387	240·4
Central Germany (Leipzig–Magdeburg area)	303	188·3
South Germany (east-west lines)	906	562·9
South Germany (north-south lines)	498	309·4
Baden (Basel–Freiburg area)	104	64·6
Berlin suburban	270	167·7
Hamburg suburban	34	21·1
Total	2,502	1,554·6

Transmission and Power

The system of transmission used is 15,000 volts A.C. $16\frac{2}{3}$ cycles single-phase current except on a few unimportant lines. This system is the same as that in Austria, similar to that in Switzerland, but different from that in Italy. The conductor is an overhead wire with the principal exceptions of the Berlin and Hamburg suburban lines,

where the third-rail system is adopted. In south Germany the source of power is largely hydro-electric; elsewhere power stations are steam-driven, burning lignite in central Germany and coal in Silesia. The Reichsbahn controls 75 hydro- or thermal-electric power stations and 1,478 transformers and converter stations, placed about 55 km. apart. In 1932 920 million kWh. were consumed.

Lines and Routes

The map of electrified lines (Fig. 53) shows the territory reached by the electrified system. The main points of interest concerning particular areas may be stated briefly.

The Silesian region. The lines in this region have severe gradients, particularly over the steep lower ridges of the Riesengebirge, e.g. Breslau—Görlitz, maximum gradient 1 in 51; Niedersalzbrunn—Halberstadt, 1 in 70; Ruhbank—Liebau, 1 in 100; Lauban—Kohlfurt, 1 in 165; Lauban—Marklissa, 1 in 145; Hirschberg—Landeshut, 1 in 40; Hirschberg—Strickern, 1 in 40 for 15 miles. Power is drawn from the railway-owned Mittelsteine power station which uses a low-grade coal. Surplus current from this station is sold to industrial undertakings.

Central Germany. The first main line to be electrified (Dessau—Bitterfeld) was converted in 1911 with power drawn from the railway-owned Muldenstein power plant, near Bitterfeld, and the Apolda plant which uses lignite. There are four substations converting to 6,000 volts and the power consumption is 50 million kWh. a year. The line has no severe gradients.

Magdeburg—Leipzig. This line was electrified in order to use economically the great lignite deposits near by. Practically all trains, except expresses beyond Magdeburg and Leipzig, are electrically hauled.

South Germany. Power for the lines south of Nuremberg, largely purchased from public undertakings, is drawn from the large modern Walchensee plant, the Mittlere Isar group (Aufkirchen, Eitting Pfrombach), Saalach, Gartenau (railway-owned) and special generators installed at the city of Stuttgart power station. Current is converted at seven substations. Since 1939 arrangements have been made to supply the lines south of Nuremberg with current from Austria.

There are steep gradients on these electrified lines. The Augsburg to Stuttgart section of 137 miles, electrified in 1933, has Geisling bank with a gradient of 1 in 44 for nearly 4 miles, and on the section

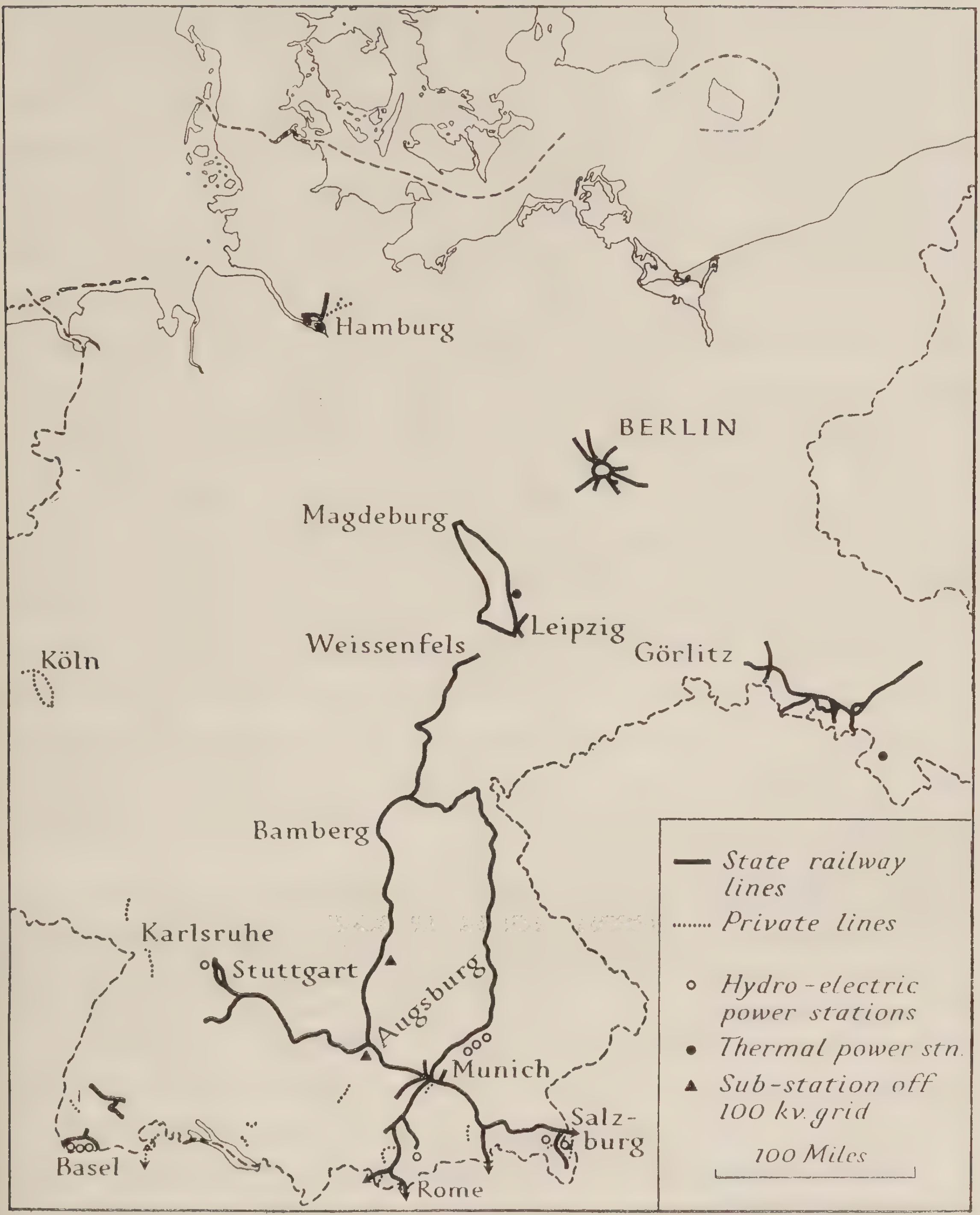


Fig. 53. Electrified railways, generating stations, and chief substations

Based on official sources.

The section to Weissenfels was completed after the outbreak of war, 1939. Arrows indicate the continuation of electrified sections across frontiers. The cities of Berlin, Hamburg and Köln are served by electrified lines for a heavy suburban traffic (Fig. 54); in Upper Silesia and central Germany electrification permits the use of poor coal and lignite (and in the former area enables severe gradients to be overcome more easily); in Bavaria electrification is based upon local resources of hydro-electric power and thus saves a considerable haulage of coal.

from Freilassing to Berchtesgaden there is a gradient of 1 in 25 for over 3 miles. Between Munich and Garmisch-Partenkirchen there are gradients of 1 in 60. The 11-mile long line from Berchtesgaden to Königsee, an early line to be converted, and the line from Berchtesgaden to Schellenberg, are operated on 1,000 volts D.C. current. Round Stuttgart there are electrified suburban lines running to Esslingen, Kornwestheim and Untertürkheim which, using power from the city of Stuttgart power station, consume 160 million kWh. a year. The line from Augsburg to Nuremberg and Weissenfels, which was electrified as far as Nuremberg in 1933 and from Nuremberg to Weissenfels in 1939, illustrate the demands of electrification. On the southern section 86 route miles had to be relaid and resignalled to permit a maximum speed of 93 m.p.h. in order to realize the maximum advantages of electrification. Power is drawn from the 100-kv. electric grid through substations at Augsburg and Treuchtlingen. The extension from Nuremberg to Saalfeld improved the services on the steeply graded lines through the Frankenwald (Thuringian Forest). Between Rothenkirchen and Probstzella there are gradients of 1 in 40 in both directions. Power for this northern extension is drawn from the Bayernwerk and from a lignite-operated plant in central Germany. The Höllental and Dreiseen railways in the Black Forest are supplied from the 20,000 volt 50-cycle single-phase electric grid.

Berlin Suburban. The 170 miles of electrified line include the Berlin-Lichterfelde Ost line converted in 1903 and the Wannsee lines converted in 1933. Power is drawn partly from the Berlin electric station at Klingenberg and partly from lignite-operated plants near Halle (Golpa-Zschornewitz and Lauta-Trattendorf). There are many substations rectifying the current to D.C. for third-rail use, but only two points for feeding in the A.C., viz. at Halensee in the west and at Markgrafendamm in the east. In the city area the rectifying stations are three-quarters of a mile apart, but in the outer suburban zone they are spaced up to 8 miles apart. About 250 million kWh. are used each year.

Hamburg Suburban. Electrified in 1908–11, this 20-mile line is operated by a system of third-rail electrification. Power is drawn from plants at Altona and Hamburg with only one substation at Barmbeck. About 45 million kWh. are used annually. A further electrified line in this district is the Altona Harbour Railway, which uses 3,000-volt 25-cycle current.

Minor electrifications. Klingenthal-Georgental railway, a minor

line only 3 miles long, is worked by 500-volt D.C. current. The lines north and west of Zinnowitz are also electrified. In the province of Baden a length of 30 miles is electrified on the Basel—Schopfheim—Zell, while the Schopfheim—Säckingen lines were converted before 1914. Power (12,000-volt 16-cycle single-phase converted on the locomotives to direct current) is drawn from the Augst-Wyhlen power station on the Rhine. About 7 million kWh. are used annually. The line Freiburg—Seebrugg—Neustadt works on 15,000-volt 50-cycle single-phase current. These local lines in Baden, converted for experimental purposes, draw some current from the Ryburg-Schworstadt and the Rheinfelden power stations.

Two short but important electrified lines are the Köln—Wesseling—Bonn and Köln—Brühl—Bonn railways which are operated by a private company. Passenger trains are electrically hauled, but goods trains are steam hauled. Current at 1,100 volts, from overhead wires, is supplied from Berggeist, Brühl, Köln and Bonn at 25 kW. 3-phase to rectifiers at Vochem and Roisdorf. This line is of standard construction and has a maximum axle loading of 20 tons; it carries considerable traffic.

Electric Locomotives

In 1939 the Reichsbahn in Germany proper possessed 571 electric locomotives, while there were also 13 owned privately. Practically all of these engines were of modern and powerful design. Locomotives are designed for both express passenger and heavy goods haulage. In 1939 they comprised the following types:

No. of driving axles	No.
2 or 3	97
4	361
6	85

The six-driving-axle type included the heavy freight locomotives of 3,400 h.p. built for hauling trains of 650 tons against gradients of 1 in 45, such as those found near Geislingen, where the line from Stuttgart to Munich ascends to cross the Swabian Jura.

Diesel-Electric and Diesel Operation

Germany led in Europe with her mileage of high-speed diesel-electric services. These services were first introduced in 1933 on the Berlin-Hamburg run; in 1937 the Reichsbahn was the only railway in the world with start-to-stop speeds of over 80 m.p.h. in the regular

time-table. Diesel-electric expresses maintained speeds of 60 to 82 m.p.h. non-stop on the Berlin—Breslau (204 miles), Leipzig—Nuremberg (200 miles) and Berlin—Hamburg (178 miles) routes. (This work by diesels did not lead to neglect of steam operation, for steam trains were scheduled at speeds up to 74·2 m.p.h.)

Besides these fast long-distance services diesel-hauled trains were used for local services and express light goods trains. The fast long-distance trains normally consist of sets of two cars powered by two 410-h.p. diesel engines with electrical transmission, whilst the slower services have many different types of diesel-engine which the Reichsbahn was standardizing as opportunity offered. The number of oil-driven railcars was 808 compared with 18 steam and 1,193 electric.

A discussion of the time-tables of these trains will be found on p. 251.

Train Control

A system of train dispatching and traffic control is used on the main-line routes of the Reichsbahn. On double-track sections right-hand running is the rule, which differs from the left-hand rule in France: in Alsace-Lorraine the track was re-organized in the 1870's to conform with the German system and remained unchanged under the French regime after 1918. Time-tables are very carefully drawn up and graphical working time-tables are freely used. Clocks at key stations are electrically controlled by a master clock at the Schlesischer station, Berlin.

Signalling of Trains

The working is conducted throughout on the absolute block system, as used in Great Britain, with space interval between trains assisted by interlocked points and signals. The signals are of the upper quadrant type. Many of the signal boxes are power-operated and the standard of equipment and of maintenance is high. Along routes where high-speed diesel-electric units have operated the signalling was greatly improved prior to their introduction. Automatic train control is extensively adopted and trains can be stopped from the track. Telephones are provided every kilometre along main lines for train crews and others to communicate with the control offices. The telegraph and telephone systems of the Reichsbahn have much equipment of the most modern type, including wireless links. The secondary and light railways are worked with simpler equipment and under simpler regulations than the main lines.

Train Speeds

In 1919 the first tests in propeller propulsion were carried out, and in 1924 came the foundation of a company to investigate transport technique. The chief problems to be examined were the efficiency of braking apparatus and the design of vehicles. The Reichbahn Leinhausen maintenance shops brought out a new streamlined propeller-driven vehicle which was tested on the Burgweld—Celle line. The acceleration of this car was considerable, 62 m.p.h. being reached in 66 seconds at 3,230 ft., and a speed of 93 m.p.h. in 2 minutes. The highest speed reached on tests was 113·1 m.p.h., but the same car later covered the Hamburg-Berlin run at an average speed of 108·1 m.p.h., reaching a maximum speed of 142·9 m.p.h., the highest speed attained on any railway. However, the success which attended the trials of diesel and steam locomotives was to divert interest from these experiments and the propeller driven vehicle was abandoned.

Meanwhile speeds gradually improved throughout the railway system as a whole. In 1926, track laid with rails weighing 98·5 lbs. per yard was suitable for speeds up to 125 m.p.h. on the straight, though the maintenance of high speeds on service runs required the flattening of curves, increase of super-elevation, reduction in the number of points and a lengthening of the interval between home and distant signals. A programme remedying these defects on twenty-two high-speed lines, totalling 5,760 miles of track, was drawn up in 1926, and afterwards R.M. 10 million were spent annually for this purpose. It is of interest to note that most of the lines affected by this scheme lay on the 'Flat high-speed country' of the North German Plain, to the north-west and north-east of the capital, land which was ideal for speed development. Sections of track which previously had included curves of $9\frac{1}{2}$ chains were reconstructed to carry curves of 25 chains, or, in exceptional cases, of 15 chains, while later a minimum of 60 chains for all curves was laid down. The new 98 ft. $5\frac{1}{8}$ in. rail was laid on 6,493 miles of track, and in order to increase the speed by 3·1 m.p.h. the following standards were adopted:

Min. radius (chains)	Max. speed allowed (m.p.h.)
20	62
30	75
40	87
50	100
80	124

High-speed Diesel Trains

In 1932, with the development of diesel traction, the first of the high-speed diesel trains was put into service. The maximum speed was then increased from 62 to 75 m.p.h. for railcars and to 68·3 m.p.h. for expresses running late. These figures, however, were greatly exceeded after the 'Flying Hamburger' was put into service. The introduction of this train was the result of the practical solution of various problems concerning the increase of train speeds, and it also involved the adoption of new operating methods which could be applied not only to railcars but to other types of traction. Moreover, it proved possible to maintain very high speeds on regular daily services, a considerable advantage in dealing with air and road competition. Further, excellent results accrued from the running of light fast trains to assist the development of railway traffic. Apart from these technical improvements it became necessary to accelerate most of the existing trains, both passenger and goods, which resulted in a change in operating methods. In spite of the considerable work involved, this revision has been carried out annually since 1930. A general acceleration and improvement have been systematically effected and each year has shown an improvement on the preceding one.

Number of runs made and train miles covered at different speeds

	At 62 m.p.h.		At 59 m.p.h.		At 56 m.p.h.	
Year	No.	Train miles	No.	Train miles	No.	Train miles
1931	—	—	—	—	2	60·3
1932	—	—	2	355·4	5	4,281·9
1933	4	712·1	4	712·1	30	2,798·7
1934	15	1,900·8	50	4,170·7	167	10,284·5

From: *Continental Bradshaw, 1931–1934* and Wiener, L., 'Note on Train Speeds,' *Bulletin of the International Railway Congress Association*, vol. 19, no. 10., p. 2010 (Brussels, 1937).

In 1934, other tests were made mainly in connexion with permanent way, especially with regard to the welding of rail joints. Speeds of between 71·5 and 90·9 m.p.h. were reached between Stendal and Salzwedel on the Berlin—Bremen run, and as a result, distant signals were moved to a distance of 1,313 yds. from the stops.

Fastest Runs

As high speeds are now very general in Germany, apart from the average whole journey speeds reached including stops, mention need

only be made of these sections where the average speed is at least 59 m.p.h. and, in the case of diesels, 62 m.p.h.

Length (in miles) of German lines run over at various overall speeds, 1937

Speed m.p.h.	Extent in miles of line run over by:			% of whole system
	FD or D trains	E trains	Together	
under 37·5	60·9	204·4	265·3	0·8
37·5–43·4	3,041·6	1,119·1	4,160·7	12·4
43·5–49·9	2,379·3	574·8	2,954·1	8·6
50·0–55·9	3,395·8	19·9	3,527·7	10·5
56·0–58·9	546·8	71·5	618·3	1·6
59·0–61·9	411·4	—	411·4	1·2
62·0–68·4	302·6	—	302·6	0·9
68·5–74·9	551·8	—	551·8	1·6
75·0–80·9	543·7	—	543·7	1·6
81·0–86·9	267·8	—	267·8	0·9
Total	11,631·7	1,989·7	13,603·4	40·1
37·5–55·9	9,096·4	1,713·8	10,642·2	31·8
Over 62·0	1,665·9	—	1,665·9	5·0

From: Wiener, L., 'Note on Train Speeds,' *Bulletin of the International Railway Congress Association*, vol. 19, no. 10, p. 2035 (Brussels, 1937).

For FD, D, E trains, see p. 248.

With 1,665·9 miles of line run over at speeds in excess of 62 m.p.h., Germany is second only to the United States for total length of high-speed runs. On account of her diesel trains she now leads in Europe for speed, while the Berlin—Hamburg train (steam), running only 2 m.p.h. slower than the *Detroit Arrow* of the Pennsylvanian Railroad, is second in the world record. The *Detroit Arrow* covered the section from Fort Mayne to Gary at 74·5 m.p.h. It is a noteworthy fact that over 1,367·3 miles of line were operated by diesels at over 62 m.p.h. and only 92 miles by electric traction, which is largely confined to the areas of sharper relief. Most of the fast lines are worked at an average speed of from 37·3–56·0 m.p.h., those between 43·5–50·0 m.p.h. being fewer than those between 50–56 m.p.h. With electric traction the mileage at 56–62·02 m.p.h. is considerably less, this decrease being still more marked at 59–62 m.p.h., whereas the mileage increases rapidly beyond. This is accounted for by the fact that when it becomes desirable to increase the speed on roads lying between 50- and 56-m.p.h. limits, a substantial improvement is made and the intermediate stage passed over.

Long Non-stop runs

Though Germany has endeavoured only recently to speed up train services she has been extending non-stop runs for some time.

Longest non-stop runs of over 93 *miles* (150 *km.*) 1937

Run	Distance (miles)	Time hrs. min.	Speed m.p.h.	Classification of train
		Steam traction		
Berlin—Nuremberg	195·1	4·00	48·8	FD 80
Berlin—Hamburg	178·3	2·24	74·3	FD 24
Munich—Würzburg	172·1	3·03	56·4	FD 263
Erfurt—Frankfurt a.M.	164·0	3·00	54·7	FD 5
Berlin—Hanover	157·8	2·33	61·9	FD 22
Berlin—Marienberg	123·0	2·28	50·0	D 15
Köln—Mainz	115·6	2·06	55·1	FD 102 (Rheingold)
Köln—Wiesbaden*	115·0	2·21	44·6	L 51 (Ostend-Vienna E.)
Berlin—Regensburg	111·2	2·41	41·4	D 322
Berlin—Hamm	110·0	1·45	62·9	FD 22
Berlin—Dresden	109·4	1·35	69·0	D 53
Hamburg—Lehrte	102·5	1·52	54·9	D 191
Berlin—Leipzig	102·5	1·37	63·4	FD 5
Berlin—Halle	100·7	1·33	64·9	FD 80
Berlin—Küstrin	100·0	1·32	65·3	D 44
Berlin—Schweinfurt	98·2	2·26	40·3	D 10
Munich—Immenstadt	95·1	2·00	47·5	D 173
Hamburg—Eger	93·8	2·04	45·4	L 106 (Karlsbad E.
		Electric traction		
Stuttgart—Munich	137·3	2·47	49·3	L 6 (Orient E.)
Munich—Salzburg	95·1	1·52	50·9	L 5 (Orient E.)
		Diesel railcars		
Berlin—Breslau	211·9	2·39	77·2	FDt 45
Berlin—Nuremberg	200·1	3·25	58·5	FDt 552
Berlin—Hamburg	178·3	2·17	78·1	FDt 2
Berlin—Frankfurt a.M.	167·2	2·27	68·2	FDt 572
Berlin—Hanover	157·8	1·56	81·6	FDt 116
Berlin—Munich	123·7	1·44	70·7	FDt 552
Trier—Köln	111·9	2·36	43·1	E 151
Berlin—Hanover	110·0	1·20	85·7	FDt 15
Berlin—Leipzig	102·5	1·17	79·9	FDt 552

From: Weiner, L., 'Note on Train Speeds', *Bulletin of the International Railway Congress Association*, vol. 19, no. 10, p. 2034 (Brussels, 1937).
Service stops marked thus *. For train classification see p. 248.

Of all the sections run over non-stop by trains at an average speed exceeding 62 m.p.h., diesel railcars account for as many as steam and electric trains together. The railcar runs include both the longest and the fastest single runs, and seven exceed the speed of the fastest steam train.

The fastest German train runs: sections of line run over non-stop at an average speed exceeding 62 m.p.h.

Run	Distance	Time	Speed	Train
		Steam traction		
Berlin—Hamburg	178·3	2·24	74·3	FD 24
Berlin—Neustadt	109·4	1·35	69·0	D 53
Potsdam—Magdeburg	72·1	1·06	65·6	D 178
Berlin—Schneidemühl	100·0	1·32	65·3	D 44
Berlin—Halle	100·7	1·33	64·9	FD 80
Berlin—Könitz	51·6	0·48	64·4	D 16
Berlin—Brieg	25·5	0·24	63·7	D 32
Hamburg—Bremen	64·6	1·01	63·6	D 211
Berlin—Leipzig	102·5	1·37	63·4	FD 5
Berlin—Bielefeld	28·6	0·27	63·4	D 9
Berlin—Hamm	110·0	1·45	62·9	FD 22
Berlin—Stendal	57·8	0·54	62·8	D 2
Berlin—Breslau	40·4	0·39	62·1	D 118
		Electric traction		
Stuttgart—Augsburg	53·4	0·46	69·7	FDt 723
Stuttgart—Munich	38·5	0·33	69·6	FDt 720
Breslau—Königszelt	30·4	0·27	67·7	D 192
Berlin—Augsburg	85·1	1·20	63·9	FD 79
		Diesel railcars		
Berlin—Hanover	111·0	1·20	85·7	FDt 15
Berlin—Hanover	157·8	1·56	81·6	FDt 116
Berlin—Leipzig	102·5	1·16	81·0	FDt 571
Berlin—Hamburg	178·3	2·17	78·1	FDt 2
Berlin—Breslau	211·9	2·39	77·2	FDt 45
Hamburg—Bremen	73·9	0·58	76·5	FDt 38
Breslau—Oppeln	51·0	0·41	74·6	FDt 45
Hamburg—Bremen	71·5	0·58	73·9	FDt 38
Bremen—Osnabrück	75·8	1·02	73·4	FDt 38
Oppeln—Heydebreck	25·5	0·21	72·8	FDt 38
Heydebreck—Gleiwitz	23·0	0·19	72·6	FDt 38
Nuremberg—Munich	123·7	1·44	70·7	EDt 552
Osnabrück—Münster	31·1	0·27	69·0	FDt 38
Berlin—Frankfurt a.M.	167·2	2·27	68·2	FDt 572
Berlin—Dortmund	19·3	0·17	68·0	FDt 16
Berlin—Erfurt	47·2	0·45	62·9	FDt 572
Berlin—Hamm	21·7	0·21	62·1	FDt 38

From: Wiener, L., 'Note on Train Speeds', *Bulletin of the International Railway Congress Association*, vol. 19, no. 10, p. 2034 (Brussels, 1937).

Note that some trains have necessarily to be included thrice over and the grand total cannot therefore be obtained by adding up the number of trains.

Passenger Trains

The average gross weight for the whole Reichsbahn system in 1936 for passenger trains was 208 tons with 22·5 axles. Regulations permit a maximum of 13 carriages to any train, but this law is often broken, especially in summer. German train services have always been char-

acterized by punctuality, although, until quite recently, not by speed. Before about 1910 there was no really fast-running train, even on the Prussian State Railway, probably the most forward of the German railways, owing to the numerous junctions and to clauses in Railway Acts which compelled all trains to stop at towns of minor importance; the paucity of long runs greatly lowered the speeds attainable. In 1937 there were 266·3 million miles of passenger train haulage carried out by steam and 35·4 million miles by electricity. The average haul for each passenger was 17 miles.

Passenger rates were substantially reduced in 1937 by the granting of special fares: 73% of all passengers travelled at reduced fares with the reduction varying from 20% for holiday tickets to 100% for persons accompanying certain categories of invalids.

The passenger traffic fell rapidly between 1928 and 1931 by nearly 25%. The passenger-kilometre figure fell by 29%, indicating a reduction in the length of the average journey. The average number of persons per train was 120·76 in 1928, but only 87·63 in 1931. Of the passengers using the trains, 3rd class form 94·44% and 2nd class 5·54%. The low percentage for 1st class, 0·02%, is due to the fact that this class occurs only on international services and on a few inter-city expresses.

Passenger Train Classification and Movement

The operation of passenger trains, and the structure of the passenger time-table, is more complicated in appearance, and in fact, than in many other countries. The position is related in part to the lower density of traffic over most lines compared with the density in England or Belgium. The first striking feature of the passenger-train system is the classification of trains into types bearing a distinguishing initial letter—a classification based upon distance traversed, speed, number of stops, passenger classes carried, and degree of connexion with cross-routes. There are six such categories of passenger trains in the German railway system:

FD	*Ferndurchgangszüge*
FDt	*Fernschnelltriebwagen*—railcar trains
D	*Schnellzüge*
L	*De luxe* trains with restaurant and sleeping cars
E	*Eilzüge*
P	*Personenzüge*
	Light trains

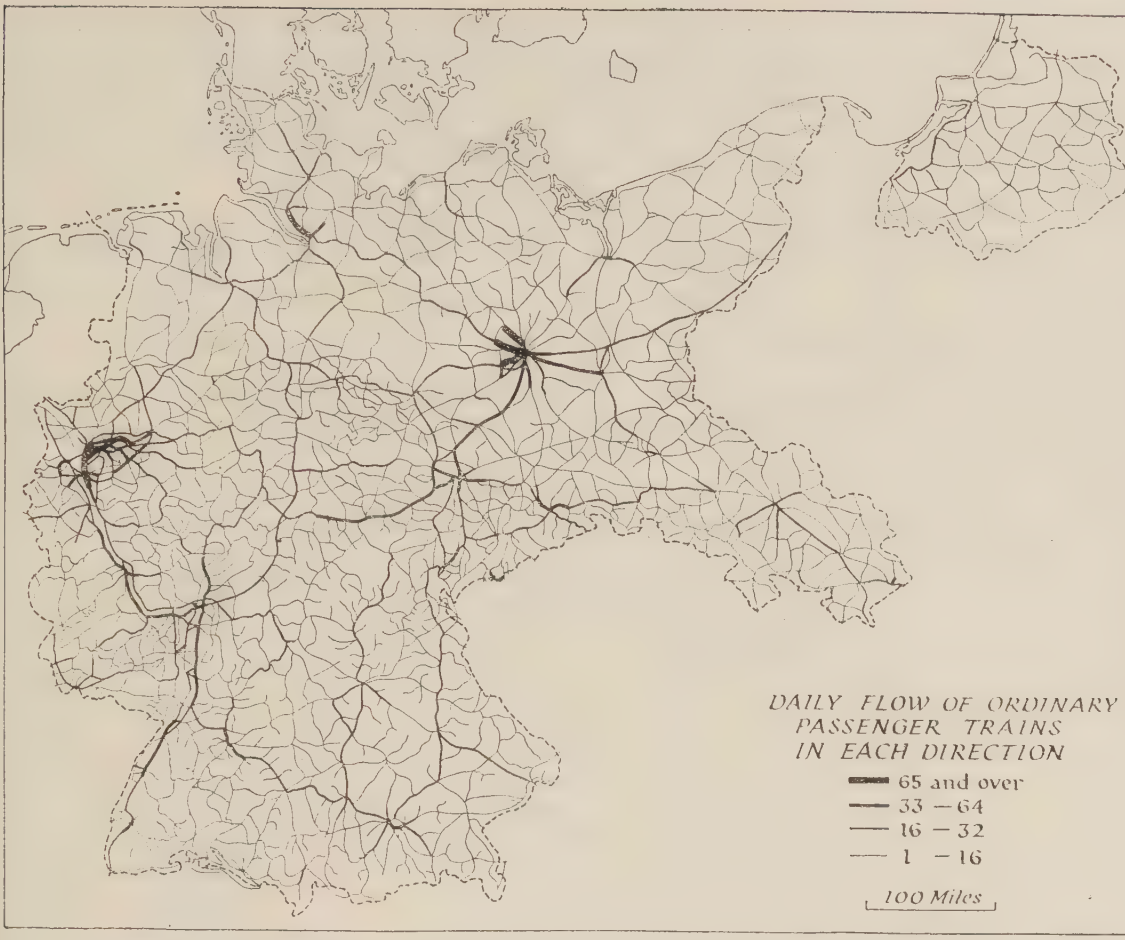


Fig. 54. Daily flow of ordinary passenger trains in each direction

Based on data from *Reichskursbuch*, December (Berlin, 1938).

This map illustrates the comparative paucity of passenger traffic in the North German Plain. It shows also that very heavy traffic is largely a short-distance phenomenon, e.g. there is no heavy traffic between the Ruhr and the rest of the Rhine valley or between Upper Silesia and the rest of Germany. The main regional lines of heavy flow reflect the routes followed by the D trains (see pp. 251–9). The urban centres of Berlin and Hamburg, with their daily movement of workers and electrified services, have a dense traffic.

FD (*Ferndurchgangszüge*)

Introduced in 1923, these are long-distance trains with only long interval stops, and carry 1st and 2nd class passengers only. In 1929 there were 15 FD trains (in both directions); ten of these started from Berlin, being supplemented by two from Hamburg; there was, also, a Bremen-Frankfurt train made up in the same way and two FD trains to the Netherlands—one to Berlin from the Hook of Holland and the other a train from Switzerland to the Netherlands (the latter was composed entirely of saloon cars, and like all such trains, was given the classification FFD).

FD trains are now subdivided into two classes, according to the service required of them. The first series, or ordinary FD's, which

Fig. 55. FDt (express diesel railcar) services, May, 1938

Based on 'Diesel Railway Traction Supplement,' *The Railway Gazette*, vol. 68, p. 967 (London, 1938).

Particular services are put on or taken off from time to time, so that maps for different periods will show small differences. Important additions during 1938 included a service on the route from Berlin to Bremen, 24½ miles longer than the route via Uelzen, but far quicker.

includes the original trains, gives fast services between centres which may be very far apart. In 1939, nine trains of this kind were still in operation, six of them linking Berlin with important provincial towns (Hamburg-Altona; Aachen; Köln; Wuppertal; Frankfurt-am-M. and Munich), and three serving the Netherlands from Berlin, Munich and Switzerland via Basel. The second series comprises the FDt trains.

FDt (Fernschnelltriebwagen)

These were introduced for the benefit of business men, and consist

of ultra high-speed trains which make it possible for long-distance passengers to leave home in the morning, work throughout the afternoon and return home in the evening. It has been found possible to run such services between places as far apart as Köln and Berlin (360 miles). With the exception of one pair of steam trains hauled by streamlined locomotives (Berlin—Dresden), high-speed railcars (*Triebwagen*) are used for all these services.

The railcars consist of two- or three-unit sets, containing one class only (2nd), together with a buffet. The first diesel rake became famous under the name *Fliegende Hamburger*, and was followed by many subsequent sets (see p. 244). In 1934 the programme of fast diesel services was published, showing the saving in time which was possible compared with the best existing timings of that date:

Run	Distance	Existing timing		Railcar timing	
	miles	hrs.	mins.	hrs.	mins.
Berlin—Hamburg	178·3	2	34	2	16
Berlin—Köln	359·8	7	40	5	0
Köln—Hamburg	279·6	5	57	4	15
Berlin—Leipzig	102·5	1	49	1	22
Berlin—Dresden	111·8	2	29	1	39
Berlin—Breslau	211·9	4	3	2	51
Berlin—Munich	418·8	8	23	6	0
Berlin—Frankfurt-am-Main	334·9	6	48	4	45

From: Leibbrand, —, *Die Reichsbahn*, no. 10, 1934, pp. 246–247.

D trains (*Schnellzüge*)

These are express trains which were introduced in 1892. D trains run long distances between stops at speeds reaching in some instances 65·0 m.p.h. They consist mainly of through coaches attached to or detached from the main rake at various points on the journey (see p. 256). This, however, tends to lengthen the stops, thereby reducing the over-all speed of the whole journey. At the present time, though there are three classes on most of these trains, some of them include only 2nd- and 3rd-class compartments. Most of the day trains include a restaurant car, and the night trains one or more sleeping-coaches. The trains are thus usually very heavy, 500–600 tons being not exceptional. Most of this class of train run long distances (300–500 miles) and the working of the through coaches necessitates a considerable number of connecting trains, both within and across the frontiers, which are run to a very close timing.

The D train network. The D trains provide the bulk of the fast services (excluding FD and FDt trains, the fastest expresses). They

may be grouped into four classes: (1) D trains radiating from Berlin; (2) D trains radiating from secondary centres; (3) Inter-provincial D trains, and special services; (4) International Transits.

D Trains radiating from Berlin. Complete D trains from Berlin run towards some thirty terminal stations, and in many cases, towns are served by several alternative lines (Fig. 56). Breslau, for example, can be reached by three main lines, via Reppen-Glogau, via Sommerfeld-Sagan or via Görlitz. Dresden is served by two lines, over which fast trains are run, while Munich may be reached via Halle and Nuremberg, or via Leipzig. As in the case of Breslau, there are variations in these routes also, some of the trains on the first of these two lines making a detour via Leipzig.

D Trains radiating from the larger secondary centres. The historical constitution of the German Reich has favoured particularly the development of large secondary centres which, on account of their importance, are connected together by long transverse lines. Thus, there are fast through trains linking Hamburg not only with Berlin, but also with Köln, Frankfurt, Basel, Stuttgart, Munich and Dresden, as well as with large towns in the Netherlands, Switzerland and Scandinavia. Through trains link Köln with Hamburg and Kiel, Norddeich, Basel, Stuttgart, Munich, Leipzig and Hof. Many other large towns may be included in this category such as Frankfurt, Basel, Stuttgart, Munich, Leipzig, Dresden and Breslau, and what may seem to be more remarkable, Aachen, Saarbrücken and Hof, which are close to the frontier. Such places, which are the starting-points of various D services are, in most cases, served as well by transit services which complete the former. There are also a certain number of other secondary centres whose importance arises from the fact that they form the junctions of various through routes; such are Hamm and Karlsruhe.

The importance of the bigger secondary centres may be seen by an examination of a town such as Munich (Fig. 56). From this centre there is sufficient traffic to justify through services even to the Netherlands, while D trains are also run between Munich and other important centres (over two alternative routes according to the usual German practice). Köln may be reached either via Stuttgart or via Würzburg, and beyond, either bank of the Rhine may be followed. D trains are run between Munich and other towns in Westphalia, e.g. Wuppertal and Dortmund, and in the case of the latter two different routes are followed which reach Munich either from the east or west. There are also two important longitudinal transverse

lines from Munich towards the north terminating at Norddeich and Hamburg, with a latitudinal branch from Hof to Breslau. Further, trains in transit between France and Austria, or from Berlin to the Tyrol, serve Munich en route, crossing the frontier at Salzburg or

Fig. 56. D train services radiating from Berlin and from Munich

Based on Wiener, L., 'Note on Train Speeds', *Bulletin of the International Railway Congress Association*, vol. 19, p. 1747, 1753 (Brussels, 1937).

The connexions with Sweden, Denmark and the Netherlands from these points are also shown.

Kufstein. Although the actual German mileage of these international services from Munich is small, the services to Austria, Switzerland and Italy are of great importance. From Munich to Innsbrück, D trains are run via Kufstein or via Garmisch-Partenkirchen and Mittelwald.

Inter-Provincial D Train Services. These are extremely well developed and are operated by D trains running partly over lines which are not directly served from Berlin, and partly over lines radiating from the capital. Important inter-provincial services are: Stettin—Küstrin; Stralsund—Dresden; Wismar—Magdeburg—Halle; Flens-

burg—Hamburg and Hamburg—Munich via Bebra; Norddeich—Giessen; Hamburg—Stettin; Köln—Kassel—Halle—Breslau; Saarbrücken — Würzburg — Dresden — Breslau; Hamburg — Leipzig; Wesermünde—Leipzig—Dresden; Hamburg—Köln. An extensive series of inter-provincial D train services covers western Germany. Fast trains in various services are routed along the Rhine during the whole or part of the journey, while the services from the Netherlands (via Kleve or Emmerich) and to Switzerland (Basel) follow the river for the greater part of its course. The local services are the more diverse and complicated owing to the general change in direction of the Rhine which occurs at Mannheim and at Mainz. Each of these two large sections is followed by trains whose routing direction is maintained after the river has been left: thus, trains from Basel to Frankfurt continue through to Berlin and Hamburg (by two different routes in each case) while the services from the Netherlands, Belgium, and Frankfurt extend to the Tyrol and Salzkammergut (via Nuremberg and Passau) or to Stuttgart and Munich.

Between Basel, Strasbourg and Berg (opposite Karlsruhe), the railway on the left bank of the Rhine is outside the Reich frontier, and many trains from Basel to the Netherlands via Strasbourg had been diverted by way of Brussels, thus giving rise to competition between the international services on the two banks of the river (see p. 261). Between Strasbourg and Appenweier in the south, and Mannheim and Frankfurt in the north, there are no less than three longitudinal lines, to which a fourth intermediate line between Mannheim and Karlsruhe may be added. These are all run over by D through trains. In addition, between Neustadt and Bingerbrück there is a by-pass which makes possible the avoidance of the Frankfurt loop, Mainz, and Wiesbaden.

Between Frankfurt and Köln the railway lines closely follow the river. Some of the important towns on one side of the river, however, are often served by important trains from the opposite bank, e.g. Wiesbaden (right bank), Mainz (left bank) and, in particular, Koblenz (left bank), which is served by trains from both sides of the Rhine. For this purpose, in addition to the direct Niederlahnstein—Neuwied line on the right bank, two connecting lines have been built up and down the river between Niederlahnstein (right bank) and Koblenz (left bank) and between Koblenz and Neuwied (right bank). Some D trains which follow the left bank as far as Koblenz, continue by the right bank to Köln and vice versa; right-bank trains, on the other hand, continue to Köln by the left bank, beyond Koblenz. Finally,

some of the right-bank trains run into Koblenz (left bank), using in turn the two connexions over the river, so that apart from this loop to take in Koblenz, they keep to the right bank of the river the whole way.

The Westphalian network is of extreme importance, for it is here that the routes westward from Berlin cross the routes northwards from Köln. D trains from Hamm and Dortmund to Köln follow three different routes: the Dortmund—Essen—Duisburg route, or the shortened route via Hagen and Wuppertal, or the northern route (the longest) via Gelsenkirchen, Oberhausen, Duisburg and Düsseldorf. In addition, certain connecting lines, also run over by D trains, may shorten or lengthen these distances. For example, the Essen—Düsseldorf section may be shortened via Essen-Werden, while between Köln and Düsseldorf there is a longer route via Neuss. In addition to the D trains serving Köln, direct D train links have been made with other towns in Germany. Such is the case with Dortmund, which is served by D trains from Munich and from Basel; from Essen (directly connected with Frankfurt, Heidelberg and Munich); and from Scherfede (connected with Breslau). Through D trains in transit across this zone frequently diverge on to several routes in order to connect with as many of these as possible. Thus Berlin and Hamm D trains towards Aachen make use of three routes: via Duisburg, via Hagen and Gladbach-Rheydt,* or via Wuppertal and Köln. These are three of the most important routes where much of the movement within the zone is latitudinal.

D Train international connexions. The fast passenger services from Germany to the Netherlands by D trains are much more highly developed than the Belgian connexions. German D trains are routed through to Amsterdam, The Hague, and Rotterdam, as well as to Flushing and the Hook of Holland. German D services to the Netherlands are covered by the following trains:

D 171/172	Amsterdam—Leipzig via Bentheim
D 173/174	Amsterdam—Berlin via Bentheim
D 173/174	Amsterdam—Basel via Emmerich
D 281/282	Amsterdam—Frankfurt via Emmerich
D 254	Amsterdam—Köln via Emmerich
D 68/67	Amsterdam—Würzburg—Vienna via Emmerich
D 164/163	Amsterdam—Basel via Kleve
D 107/108	Rotterdam—Munich via Kleve.

* The town long known as München-Gladbach is now properly called Gladbach-Rheydt, but the older name, or the form 'München-Gladbach-Rheydt', are still frequently employed.

Most of these trains include through coaches. For Amsterdam, The Hague and Rotterdam, such coaches are worked to the destinations by means of other connecting D trains. Towards Belgium no D train except the Vienna—Passau service is routed farther than Köln.

An important change has been made in the German-Swiss D services; whereas they were formerly worked along both banks of the Rhine, latterly they have been routed along the Baden (right) bank.* The routing of certain trains (see p. 254) was particularly affected by this change. A similar change was made in Silesia, where the Berlin—Breslau main line was originally routed via Oels, Kreuzburg, and Czianu, reaching Kattowice via Lablinitz, the latter section being entirely in Poland. All the fast services have now been diverted to the Breslau—Oppeln—Heydebreck line and beyond Oels, and the old line is now merely a regional one. Mention should also be made of transits through Poland and Danzig. The Königsberg line crosses Poland for 130 miles (see p. 399) between Firchau and Dirschau, and the Danzig territory for 11 miles between Dirschau and Marienburg. The Allenstein section crosses Poland for 190 miles between Neu Bentschen and Deutsch Eylau.

Through Coach working (*D train*). Germany, more than any other country, has developed the practice of using through coaches between innumerable places, which necessitates continuous re-marshalling. Whereas in other countries the passengers change trains, in Germany the coaches are shunted. The pattern of the through coach network depends upon many factors, especially the density of population and the intensity of passenger traffic between secondary centres. Where coaches are transferred it is essential to regulate the working exactly, as the slightest delay sets up far-reaching effects on the network owing to the sequence of the connexion.

Interconnexions from one basic D train. To make the effects of this operating method clear an examination of some D train services, the districts served by them and the connected timing, is of interest. By abstracting from the time-table all the trains whose timings are dependent upon a basic train it is possible to map all the interconnexions with the second series and so on. In Fig. 57 the route of train D33 (Berlin—Beuthen) is shown, together with the routes of through coaches attached to or detached from it. Whereas train D33 runs 357 miles, the distance covered by the through coaches, which

* The route via Schwetzingen makes it possible to avoid Mannheim by diverting the trains from the central (Mannheim) line to the western (Darmstadt) line.

are divided among four other D trains, is 1,413 miles. These four fast D trains follow routes of which the lines plotted on the map are only sections, and during these journeys other through coaches are attached or detached. If all these through runs are totalled, the mileage amounts to 15,670, and 62 different trains are involved for

Fig. 57. The working of train D 33 (Berlin—Breslau—Beuthen), 1937
Based on data from *Reichskursbuch*, 1937

working the coaches from one D train to another.* The route followed by train D33 from Berlin to south-east Germany can in consequence affect the operation of a very considerable part of the railway network over all the southern states from Saxony to Baden,

* Forty-three D, two L, ten E and seven P trains. Among the D trains there are ten centered on Berlin and, owing to the exchange made of through coaches, some of these run towards Berlin while others start from the capital. The same line may also be run over by as many as three trains, which all interfere directly or indirectly with the basic train.

as well as the Rhineland, Westphalia and Hamburg areas. In addition, there are extensions of these trains into the Netherlands (Amsterdam —Rotterdam, Flushing), Switzerland (Geneva, Lucerne, Zürich and Chur), Italy (Milan) and Austria, involving 45 sleeping-car services, 22 of which are internal and 23 international. Besides serving important provincial capitals and other towns, these trains serve several resorts—Bad Kissingen, Wiesbaden, Baden-Baden, Oberstdorf and Bad Kudowa. It should be borne in mind that only through coaches have been considered above—connected timings have been excluded. Thus in addition to the main network already considered the secondary network, including a large number of medium mileage runs, is also affected. The importance of the inter-connexions and the work involved in changing the timings of any one train in the series without revising all the others is therefore very great. Further, if all the trains mentioned above are based on D33, the reverse also applies and any other of these interfering trains makes the same connexions. The whole system, therefore, forms a complete unit and the annual revision of time-tables (see p. 244) to keep pace with increasing speeds in view of the number of closely-timed connecting services, is thus a considerable achievement.

To interpolate goods trains on lines with heavy, fast-flowing and closely-timed traffic raises considerable operating problems. Latterly the more general use of the continuous brake on goods trains has been of great assistance. Maximum speeds of goods trains were fixed at 43·6 m.p.h., at 46·6 m.p.h. with some stock, and at 56 m.p.h. with special wagons. Goods motor vans running at 80·8 m.p.h. have also been designed for interpolation between fast trains.

If a through train is running late, the usual practice is to maintain the branch train connexions or to utilize the following branch line train and, so far as following stopping trains along the through route are concerned, to start them punctually and send them on as far as they can get, divert them into a loop road and stop the through train especially to exchange passengers. The connexions for these passengers, luggage and parcels for points between the starting-point of the stopping train and the point arranged for exchange is thereby broken, but time is frequently made up by this procedure as the time-table stops of 5–10 minutes may often be carried out in two or three minutes. This last measure is taken to maintain the journey as a whole—a policy by which the users of the stopping trains (P trains) sometimes benefit. If this connexion is broken the tickets may be endorsed for a fast or express train (E or D) to catch up

the connexion further along the line, or are made available by an alternative route.

L Trains

The L class are 'de luxe' trains with restaurant or sleeping-car stock operated by the *International Sleeping Car Co.* or by the *Mitteleuropäische Schlafwagen und Speisewagen Gesellschaft* (*Mitropa*). Both companies have very largely contributed to the establishment and development of the great European expresses, and between them operate several thousand saloon coaches. Many of the L trains are international expresses and the German network carries more of this class of express than any other network in Europe. The L trains are usually very heavy, so that their timings are less exacting than those of the FD trains. They nevertheless run very long distances non-stop.

Germany's international expresses (Fig. 58) may be divided into five groups according to their direction of transit or origin (see also p. 261).

Direction	No. of Expresses
From west to east	2
From west to south-east	4
From north to south	2
Expresses radiating from Berlin	12
Expresses running from other centres	1
Total	21

The International Sleeping Car Co.'s German Services. It is difficult to determine the exact date when the first European sleeping-car was introduced, but the Ostend—Köln and Köln—Berlin services were among the first. The 'de luxe' trains now include through services and trains linking up Berlin with other cities and capitals. The oldest of these expresses is the *Orient Express*, one of the three great latitudinal expresses * from Paris to Vienna and the Balkans, which ran for the first time on 5 June 1883. The train has played a dominant part in the development of the European international services and, further, it has had a political influence greater than any other train with the exception of the Simplon-Orient. After the war of 1914–1918 it was found indispensable for political and military reasons to re-establish the train immediately and it was re-routed through south Germany, running three days per week. At Stuttgart a rake, known

* The three great latitudinal expresses are (i) the *Nord Express* in the north; (ii) the *Orient Express* in the centre; (iii) the *Simplon—Orient Express* in the south. The last-named train does not cross the Reich frontier and is therefore not considered in this account. Running from Calais to Paris, Milan, Belgrade, Athens and Istanbul, it is doubtless the most important European express.

as the *Carlsbad Express* before 1914 and now called the *Paris—Prague*, is detached from this train and serves Czechoslovakia. The *Ostend—Vienna Express*, which dates from 1 June 1894, was extended to Istanbul in 1901.

The *Nord Express*, the greatest northern latitudinal express, which runs right across Germany from Aachen, dates from 1896 (the Warsaw rake being added three years later), but in 1939 this service was reduced to two sleeping-cars attached to an ordinary D train. In 1921 the Riga rake was introduced. Two other through coaches are worked on the *Nord Express* giving interesting connexions: Copenhagen—Hanover, and Ostend—Bucharest (via Berlin and Breslau), which gives a connexion between Ostend and Bucharest on days when the *Ostend—Vienna* Express is not run. Although the routes via Berlin and Vienna are far apart, the difference in route mileage is only 2% (1,577·7 and 1,622·4 miles respectively).

Berlin is served by many international services, linking it with the Near East, with Carlsbad and Vienna, with Switzerland, Italy and the Riviera. The three Carlsbad expresses from Paris, Ostend and Berlin run right across Germany. Two of these expresses are, in fact, only rakes from other 'de luxe' trains, e.g. the *Paris—Carlsbad—Prague* (1901) breaks away from the *Orient Express* at Stuttgart, while at Nuremberg the *Ostend—Carlsbad* (1901) is picked up, having been detached from the *Ostend—Vienna* (1894). Only the Berlin route has a special train and, like the Ostend train, it also used to serve Marienbad, and for some time was extended as far as Vienna as the *Berlin—Vienna* (1901) express.

Four 'de luxe' trains, one of which was a boat-train, linked Berlin with Munich and the Brenner Pass by the same route. The *Egypt Express* connected at Naples with the Norddeutscher Lloyd vessels from Alexandria; the *Berlin—Rome Express*, the *North-South* (*Brenner*) *Express* and the *Berlin—Tyrol—Rome Express* were trains from Italy.

Three trains served Switzerland, Italy and the Riviera via the left bank of the Rhine and the St. Gothard. There were the *Lloyd Express* (also a Norddeutscher Lloyd boat-train); the *Berlin—Switzerland Express* which connected with the *Ostend—Switzerland* and the *Amsterdam—Switzerland* at Basel; and the *Riviera Express* which started from Berlin and Amsterdam. At Mulhouse a rake was detached for the French Riviera via Lyons. The present-day *Riviera Express* results from the amalgamation of two series of trains. Those via the Alsatian bank of the Rhine and Basel were diverted to the

Baden bank and the St. Gothard, while the *Berlin—Rome*, via the Brenner, was made to follow the same route and incorporated in the former train. The result is that the present *Berlin—Milan Express* via the St. Gothard includes two rakes, one to the Riviera which is reached by the eastern end of the other for Rome, replacing the former Berlin—Brenner—Rome service. Apart from two exceptions the present 'de luxe' trains follow the same routes as before the war of 1914–1918; there are no longer any on the Berlin—Frankfurt section, while a sleeping-car detached from the *Nord Express* is sent to Beuthen, and sleeping-cars worked in two 'de luxe' trains are sent over lines which formerly had no such services: from Hanover to Paderborn (*Nord Express*) and from Köln to Emmerich (*Ostend—Vienna Express*).

Mitropa Services through Germany. Outside Germany the trains operated by this company are little known. Two 'de luxe' trains which ran during the years of prosperity have now been withdrawn; these were the *Berlin—Hook of Holland Express* via Bentheim, which was introduced in 1922, and the *Scandinavia—Switzerland Express*, which picked up at Rostock coaches from the ferry-boat termini at Warnemünde and Sassnitz. The day train, the *Rheingold*, which ran for the first time in 1928 and soon became famous, was at first composed of drawing-room cars. This train, composed of magnificent stock, linked Amsterdam and the Hook of Holland with Basel via the right bank of the Rhine, following the same route as the *Amsterdam—Switzerland Express* of the *International Sleeping Car Co.* This company's rival train, the *Edelweiss*, linked the same places, but ran via the left bank of the Rhine and therefore outside the Reich frontier. Both trains latterly decreased in importance.

German Sections of L Expresses

Origin	German section	Destination	Name of train
From west to east:			
Ostend; Calais; Boulogne; Paris	Aachen—Berlin—Neu Bentschen	Warsaw	Nord E.
Paris	Aachen—Berlin—Eydtkuhnen	Riga	Nord E.
Paris	Aachen—Hamburg	Copenhagen	Nord E.
Paris	Aachen—Berlin—Breslau	Bucharest	Nord E.
Calais, Paris	Kehl—Cheb (Eger)*	Carlsbad; Prague	Paris—Prague E.

* German-managed tracks run across the frontier to Cheb in Czechoslovakia, or ' Eger ' as it is known in Germany.

Origin	German section	Destination	Name of train
From west to south-east:			
Ostend	Aachen—Frankfurt—Nuremberg—Passau	Trieste; Istanbul; Constantza	Ostend—Vienna E.
Amsterdam	Emmerich—Frankfurt—Passau	Bucharest	Ostend—Vienna E.
Ostend	Aachen—Köln—Nuremberg—Cheb (Eger)	Carlsbad	Ostend—Vienna E.
Paris, Calais	Kehl—Munich—Salzburg	Istanbul	Orient E.
Paris	Belfort—Basel	Salzburg	Arlberg Orient E.
From north to south:			
Amsterdam; The Hague	Emmerich—Frankfurt	Chur	Amsterdam—Switzerland E.*
	Schwetzingen—Basel	Chur	
Amsterdam; Hook of Holland	Emmerich—Mainz—Basel	Zürich; Lucerne	Rheingold E.
International services radiating from Berlin:			
Berlin	Liegnitz—Oderberg	Budapest	Berlin—Budapest Orient E.*
Berlin	Leipzig—Cheb (Eger)	Vienna; Carlsbad	Berlin—Vienna E.*
Berlin	Leipzig—Cheb (Eger)	Carlsbad; Marienbad	Berlin—Carlsbad—Marienbad E.*
Berlin	Breslau—Beuthen	Budapest; Istanbul	Simplon Orient E.
Berlin	Dresden—Bodenbach	Prague; Athens	Simplon Orient E.
Berlin	Leipzig—Munich—Kufstein	Naples; Alexandria	Egypt E.
Berlin	Leipzig—Munich—Kufstein	Palermo; Taormina	Berlin—Palermo E.*
Berlin	Leipzig—Munich—Kufstein	Merano; Milan; Cannes	Nord—Sud Brenner E.*
Berlin	Leipzig—Munich—Kufstein	Vienna; Rome	Berlin—Tyrol—Rome E.*
Berlin	Halle—Frankfurt-am-M.—Basel	Lucerne	Berlin—Switzerland E.*
Berlin	Halle—Mulhouse—Petite Croix	Chur; Genoa	Lloyd—Riviera E.*
Berlin	Halle—Mulhouse—Petite Croix	Lyons; Ventimiglia	Lloyd—Riviera E.*
Berlin	Leipzig—Frankfurt-am-M.—Basel	Cannes; Rome	Riviera E.
Berlin	Hanover—Bentheim	Hook of Holland	Berlin—Hook of Holland E.*
International services radiating from other centres:			
Köln	Köln—Aachen	Ostend	Ostend—Köln E.

From: *Continental Bradshaw* and Wiener, L., *Bulletin of the International Railway Congress Association*, vol. 19, no. 8, pp. 1780–2 (Brussels, 1937).

* Denotes services withdrawn at various dates, mainly since 1935.

Sleeping-car services in Germany. Both the *International Sleeping Car Co.* and *Mitropa* penetrate to the most outlying parts of the Reich and across the frontiers when permitted. The internal services end at Westerland in the north, at Aachen and Saarbrücken in the west; at Friedrichshafen, Oberstdorf, Garmisch-Partenkirchen and Berchtesgaden in the south, and at Tilsit and Eydtkuhnen in the east. In order to give through day or night services between important towns 3–5 sleeping-cars are often included in one train over the whole or part of the journey. The longest sleeping-car service is from Berlin to Basel via Magdeburg (581 miles), the return journey being worked via Worms and Frankfurt-am-Main (551 miles); the shortest section is Berlin—Hamburg (182 miles).

E Trains (Eilzüge)

E trains are fast trains with 2nd and 3rd class compartments only. They are slower than the FD trains and are sometimes as fast as the D trains, but stop more frequently. On the other hand, they are not re-marshalled so often during the journey. The fastest over-all speed of an E train is 56·5 m.p.h. on the Berlin-Görlitz line. As on FD and D trains, a supplement is charged, though the amount is smaller. These supplements are based on zones of 46·6 miles (74·9 km.)

P trains (Personenzüge)

This class covers all local trains. After 7 October 1928, when the 4th class was abolished, they were reduced to two classes only—2nd and 3rd.

Light Trains

The Bavarian State railways were the first to make a systematic investigation into the question of light trains, though such trains had been run for some time, especially in Belgium. The Bavarian railways wished to increase the passenger traffic by speeding up the services and making frequent stops on both main and secondary lines, and eventually introduced light trains which could be staffed by a driver/guard and stoker/conductor. To shorten stops the trains did not carry mails, parcels, milk or cattle, and special stock was designed. The first trains were instituted in 1909 between Munich and Nuremberg via Ingolstadt and the number was soon increased. A special type of 4–4–0 locomotive connected to the brake van by a gangway was put into service with four coaches, the total weight being 83 tons. In 1935, 2–4–2 T engines were introduced to haul light trains, or trains

composed of two heavy coaches. They could run at approximately 50 m.p.h., taking two minutes to reach the maximum speed.

Goods Trains

The average gross weight for the whole Reichsbahn system in 1936 for goods trains was 701 tons with 78·6 axles: net goods train load was 307 tons. These figures are averages of all trains, from local trains of low weight to coal trains which may reach 1,200 tons net (i.e. nearly 2,000 tons gross). The average number of goods vehicles per train in 1937–8 was 35·5, which compares with 49·5 for U.S.A. Class I railways. Since 1920 the Reichsbahn has endeavoured to increase the capacity of the railways for mass movement; the system achieves a greater haulage per train than in Great Britain, but much less than in the United States, where the track and rolling stock are constructed for heavier and longer train hauls. The average haul per ton in 1937 was 99·4 miles. During this year there were 170·5 million miles of goods train haulage by steam and 7·2 million miles by electric trains.

The normal main-line goods train had an average speed of 20 to 25 m.p.h. with a maximum of 46·6 m.p.h.

There was a severe drop in the goods traffic between 1929 and 1931 when it fell by about 33% to 325·6 million tons. Of the goods hauled on German railways in 1931, 80·8% was on the Reichsbahn, 8·0% on private lines, and the remainder comprised foreign-consigned and transit traffic. In 1937 the following goods and minerals were hauled:

Category	Million tons
Express goods	2·3
Slow ,,	446·3
Service tonnage	50·4

Service tonnage included about 14 million tons of loco. coal as well as constructional materials, ballast, etc.

The service haulage of 36 million tons of materials indicates the inaccuracy of the statements sometimes made that German railways were under-maintained in the years immediately before 1939.

Marshalling Yards

The Reichsbahn operating organization is unique in that the goods train services are based on marshalling-yard working in contradistinction to the British, American and French systems where the services are based on the required hour of arrival, at the destination point.

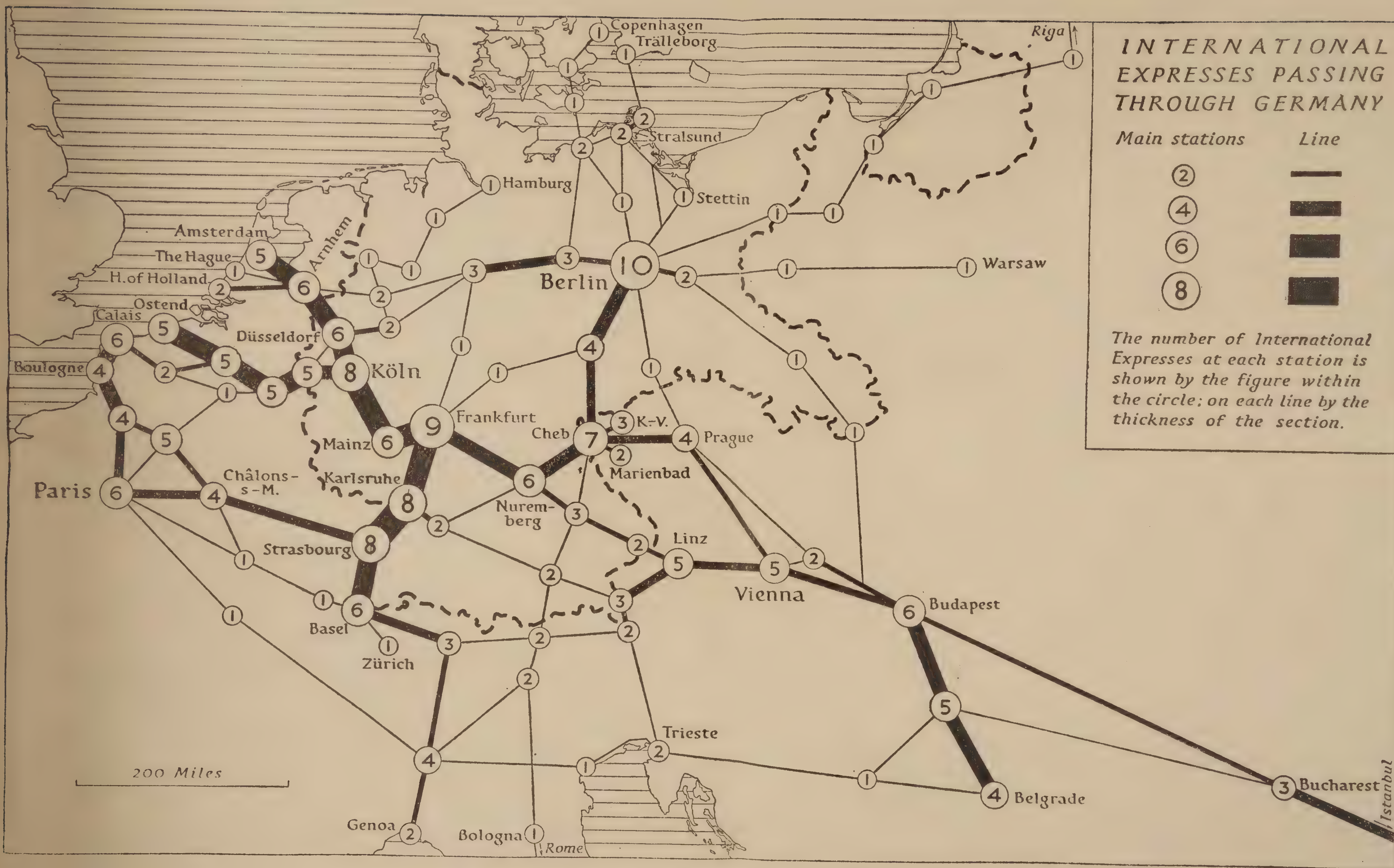


Fig. 58. European expresses working over German territory, 1937

Based upon the *Continental Bradshaw* 1937.

K.-V. Karlovy Vary (Carlsbad). Only those expresses carrying *International Sleeping Car Co.* or *Mitropa* stock are included. Where an express orginates as separate carriages or as sections from different termini, e.g. the *Nord* at Paris, Calais and Boulogne, it is counted at each such terminus, but at the point where such sections come together, e.g. at Namur (*Nord*), Châlons-sur-Marne (*Orient*), Köln (*Ostend—Vienna*), the express is counted only once.

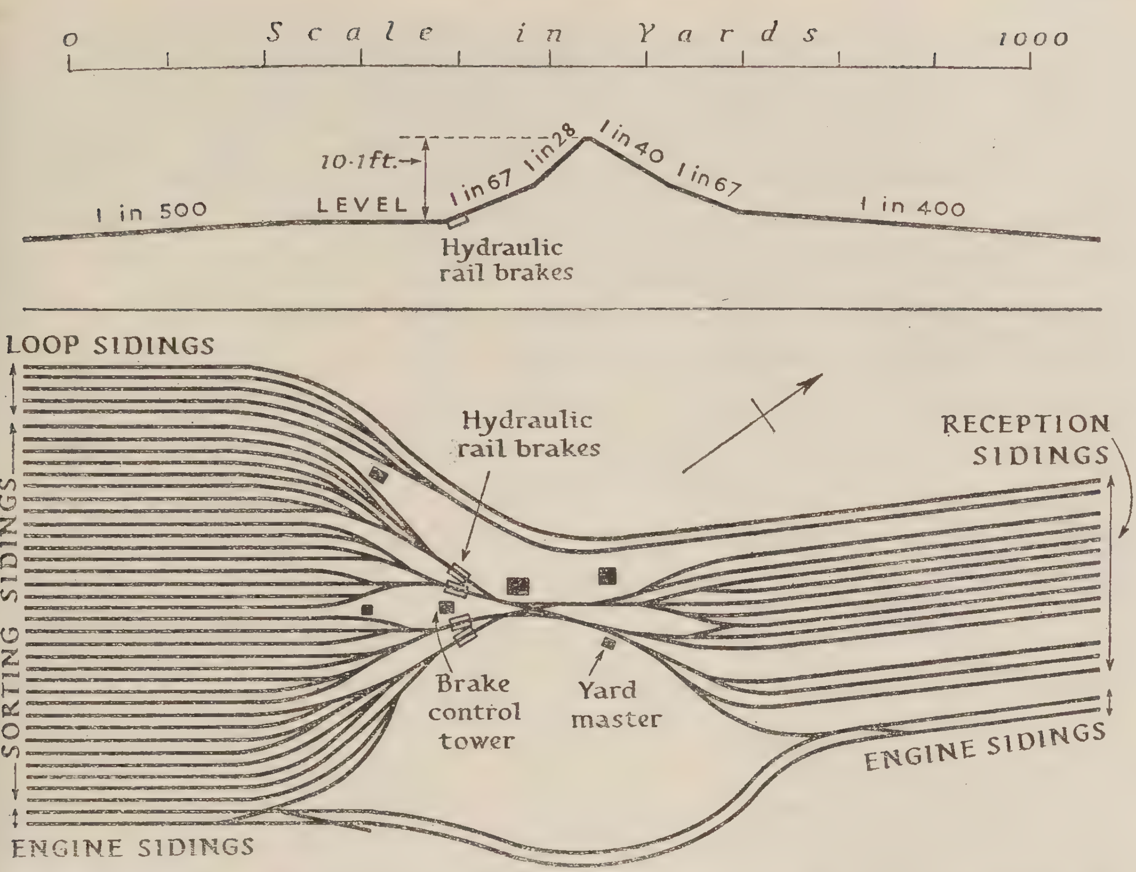


Fig. 59. Hamm marshalling yard: layout and gradient profile of the reception and sorting sidings and the hump between them

Based on 'Notes and News', *The Railway Magazine*, vol. 86, p. 611 (London, 1940). This diagram illustrates the key section of the yard. Wagons move from right to left. They are pushed up the hump and, descending the other side by gravity, their speed is checked, according to their weight, by the hydraulic brakes and they pass from the 'king-points' at a steady speed into the sorting sidings. The master points are worked from a yard box by pre-selection cut-cards and thus the visual and audible signalling required is reduced and the time taken to break up and re-form trains is greatly shortened.

Some features of the most favoured lay-out are:

1. Reception and humping roads combined;
2. Sorting sidings with the 'balloon' pattern as standard;
3. Sorting sidings often used as departure roads so that the trains draw out direct;
4. Transhipment points for improving wagon loading;
5. Small hump groups for shunting out special groups for trains and forming local trains
6. Location of engine sheds, coaling and watering plants, etc., in the middle of a double-sided yard with independent engine roads as well as a small wagon repair shop.

There are three main types of marshalling-yards: (1) the flat yard; (2) the hump yard; (3) the gravity yard. The flat yard is an ordinary

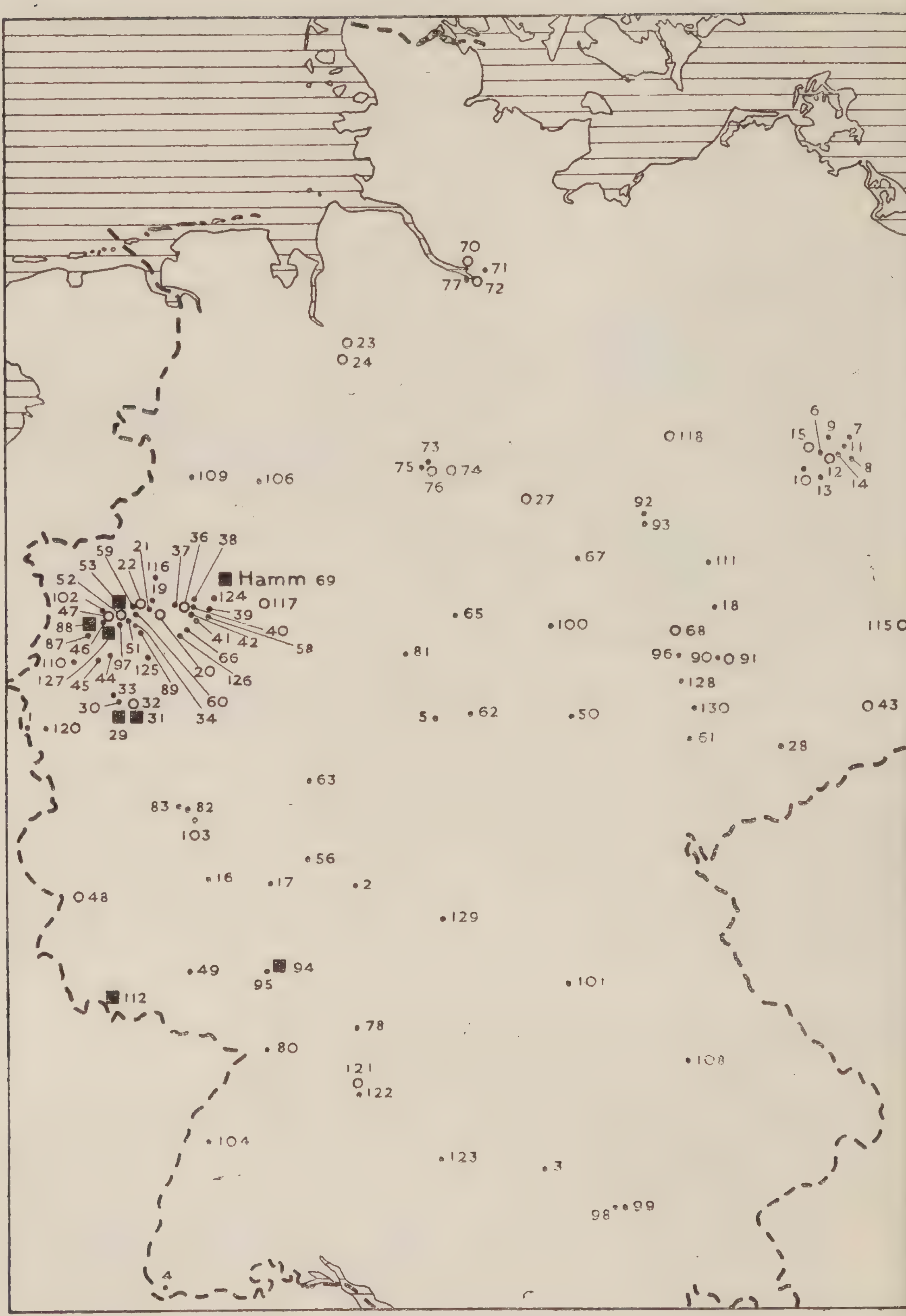


Fig. 60. Principal marshalling yards in west Germany

Based on official sources.

For key to numbers, see opposite page; for key to capacities, see Fig. 61.

shunting yard with a shunting neck ; wagons are sorted by to-and-fro movement of a locomotive to the various sidings. Through capacity of such yards is low. With both the hump and gravity yards the ideal is a series of three yards; viz. the reception, sorting and departure sidings. There are few gravity yards and the principal ones are in south Germany, e.g. at Nuremberg, Dresden-Fredrichstadt, Chemnitz-Hilbersdorf and Engelsdorf. With the hump yard an artificial incline is provided from the summit of which wagons run over 'king points' to sorting sidings, while with the gravity yard the movement is given by the natural lie of the ground. Control of the wagons is attained by the operation of electrically operated brakes or retarders situated on the track, and this type of apparatus has been mainly developed in Germany. It was found that with railbrakes the percentages of time effectively spent in a shift rose from 46·4 to 72·6 when these were installed, with a consequent great increase of the

No. on map	Yard	Capacity	No. on map	Yard	Capacity	No. on map	Yard	Capacity
1	Aachen-West	3,000	45	Neuss	2,200	93	Magdeburg-Rothensee	3,000
2	Aschaffenburg	3,000	46	Duisburg Hbf.	3,600	94	Mannheim	7,000
3	Augsburg	2,300	47	Ruhrort-Hafen neu	5,000	95	Ludwigshafen	2,200
4	Basel Rbhf	2,400	48	Ehrang	4,000	96	Merseburg	2,000
7	Lichtenberg-Friedf.	2,700	49	Einsiedlerhof	3,500	97	Mülheim-Speldorf	3,000
8	Nieder-Schonweide	3,500	50	Erfurt	2,600	98	Munich-Laim	2,900
9	Pankow	2,700	51	Essen	2,600	99	Munich-Ost	2,000
11	Rummelsburg	2,700	52	Essen-Frintrop	5,400	100	Nordhausen	2,000
13	Seddin	2,400	53	Osterfeld-Süd	6,800	101	Nuremberg	2,900
14	Tempelhof	2,900	56	Frankfurt-am-Main	2,700	102	Oberhausen-West	3,100
15	Wustermark	5,000	58	Geisecke	3,000	103	Oberlahnstein	2,000
16	Bingerbrück	2,000	59	Gelsenkirchen Hbf.	2,000	104	Offenburg	3,200
17	Bischofsheim	3,200	60	Gelsenkirchen-Schalke	2,200	106	Osnabrück	2,100
18	Bitterfeld	2,000	61	Gera	2,000	108	Regensburg	2,000
19	Herne	2,400	62	Gerstungen	2,000	109	Rheine	2,000
20	Langendreer	5,000	65	Göttingen	2,600	110	Rheydt	2,500
21	Bochum-Riemke	2,200	66	Hengstey (Hagen)	2,350	111	Rosslau	2,250
22	Wanne-Eickel	5,200	67	Halberstadt	2,200	112	Saarbrücken	6,000
23	Bremen	4,100	68	Halle	4,500	115	Senftenberg	4,000
24	Kirchweyhe	5,000	69	Hamm	10,000	116	Sinsen	2,000
27	Brunswick-Süd	4,000	70	Eidelstedt	4,000	117	Soest	4,000
28	Chemnitz-Hilbersdorf	3,500	71	Rothenburgsort	3,300	118	Stendal	4,500
29	Köln-Eifeltor	6,000	72	Wilhelmsburg	4,800	120	Stolberg	2,000
30	Köln-Gereon	2,000	73	Hainholz	2,100	121	Stuttgart-Kornwestheim	4,000
31	Gremberg	6,000	74	Lehrte	4,000			
32	Köln-Kalk-Nord	4,500	76	Seelze	5,000	122	Stuttgart-Unterturkheim	2,200
33	Köln-Nippes	3,500	78	Heilbronn	2,000			
34	Dalhausen	3,600	80	Karlsruhe	3,300	123	Ulm	2,400
36	Dortmund	4,800	81	Kassel	2,300	125	Vohwinkel	2,800
38	Dortmund-Eving	2,000	82	Koblenz	2,600	126	Vorhalle	3,800
39	Holzwickede	2,400	87	Krefeld	2,000	127	Wedau	7,200
40	Dortmund-Süd	2,400	88	Hohenbudberg	6,700	128	Weissenfels	2,400
41	Schwerte	2,200	89	Kupferdreh	2,600	129	Würzburg	2,000
42	Dortmunderfeld	3,000	90	Leipzig-Engelsdorf	3,700	130	Zeitz	2,600
43	Dresden-Friedrichstadt	4,000	91	Leipzig-Wahren	4,500			
44	Düsseldorf-Derendorf	2,100	92	Magdeburg-Buchau	3,800			

Three important yards not shown on this map are Oldenburg (2,000 wagons); and the two yards at Falkenberg, south of Berlin (3,500 and 2,500 wagons). Yards located on the map, but with capacities probably below 2,000, are: Bebra (5); Berlin-Grünewald (6); Berlin-Potsdam (10); Berlin-Schönberg (12); Dortmund-Dorstfeld (37); Giessen (63); Minden (75); Harburg (77); Koblenz-Lützel (83); Unna (124).

through flow of wagons. A wagon now only stays 5 hours in a gravity yard. One result of this mechanization and concomitant reduction in time was that the work of thirty yards in the Essen R.B.D. could be concentrated in five yards.

The largest marshalling-yard in Europe is at Hamm (Fig. 59). The point operation at this yard is remarkable for the concentration of all point levers in one cabin and the pre-selective operation of the points by a system of punched cards passing through the master machine. The L.N.E.R. Whitemoor Yard, near March, was modelled on Hamm.

Goods Train Operation

The usual principles actuate the policy for conducting goods train operation. The object of attempting to get full engine loads for goods is being pursued (it is double the figure for Great Britain), and during the late thirties the figure was being improved by having marshalling-yards which were geographically well sited, a well-equipped information system, and the forming of completely fitted trains with good wagon loading. In addition, the cost of operating certain routes has been well studied, and goods trains are worked over the cheapest route, which on the map may often appear to be the longest.

Since 1926, great attention has been paid to the collection of accurate information as to the actual flow of wagons on transit, and a very complete system has been developed with a view to improving train loading, train routing, and other economies. This material can be obtained from records kept at stations of arrival and departure. The necessary return is made by all goods yards having an output capacity of 2,000 or more wagons per day (119 yards), and has been found so useful that the return is now made regularly.

The tendency in Germany is to reduce the number of yards to a minimum by concentrating neighbouring yards, and by increasing the capacity of those that remain. This has necessitated, in some cases, the building of new goods lines to provide direct access from the main trunk routes in order to secure the full use of the yard and to enable better train loading to be achieved, especially with 'through' goods and, to some extent, with 'local' goods as well. With the larger yard a better opportunity of concentrating traffic is given, and it is often possible to arrange, on the existing mileage, for one train to serve the first group of stations, and another to serve the second group, and so on, thus again reducing the transit time.

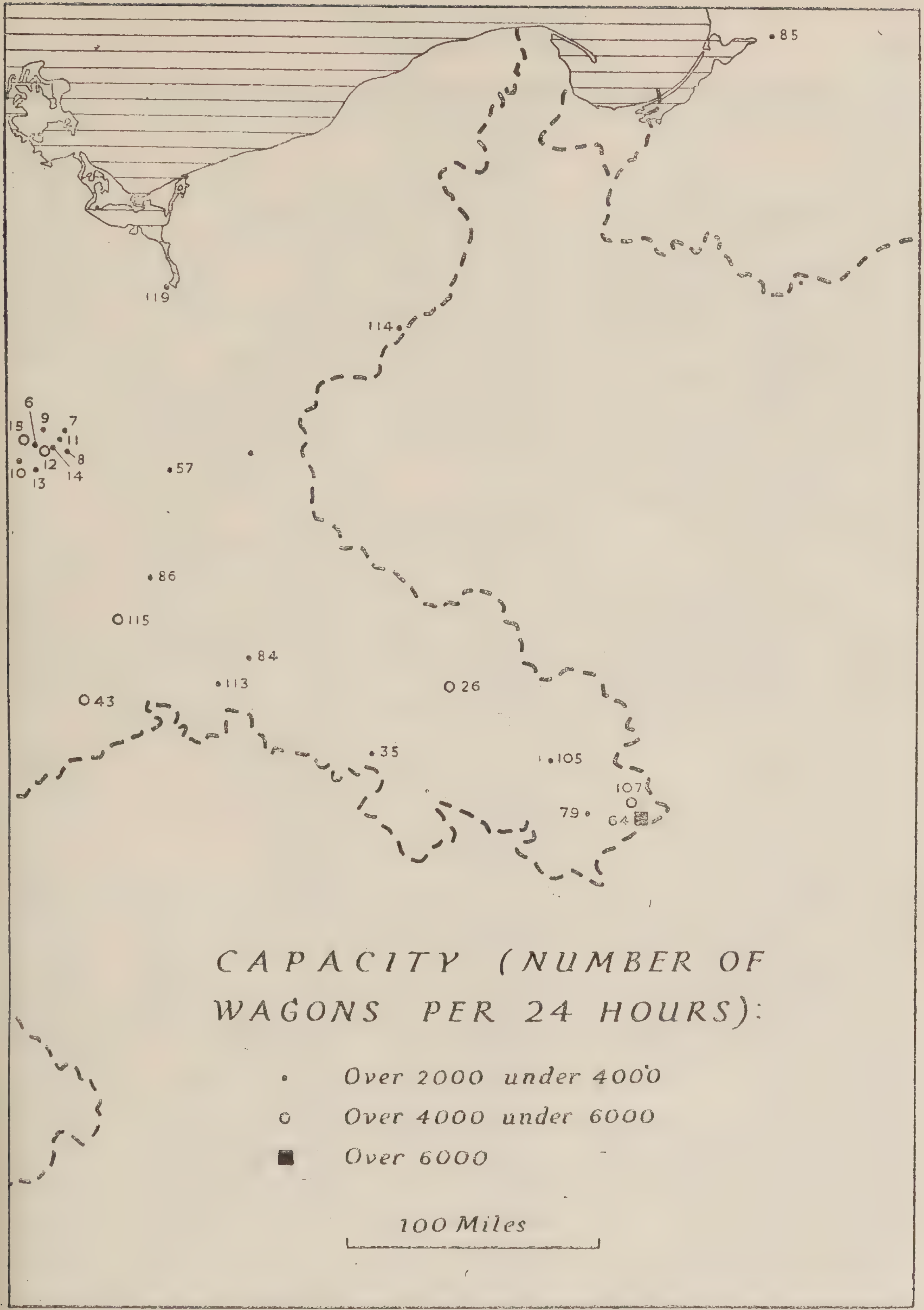


Fig. 61. Principal marshalling yards in east Germany

Based on official sources.

The following yards shown on the map have wagon capacities over 2,000 per 24 hours (the figures in brackets indicate the capacity): 7, Lichtenberg-Friedf. (2,700); 8, Nieder-Schönweide (3,500); 9, Pankow (2,700); 11, Rummelsburg (2,700); 13, Seddin (2,400); 14, Tempelhof (2,900); 15, Wustermark (5,000); 26, Breslau-Brockau (5,000); 35, Dittersbach (2,000); 43, Dresden-Friedr. (4,000); 57, Frankfurt-an-der-Oder (2,700); 64, Gleiwitz (6,800); 84, Kohlfurt (2,200); 85, Königsberg (2,200); 86, Kottbus (2,000); 107, Peiskretscham (5,000); 113, Schlauroth (2,400); 114, Schneidemühl (2,500); 115, Senftenberg (4,000); 119, Stettin (2,500); Other quite important yards are: 6, Grünewald; 10, Potsdam; 12, Schönberg; 79, Heydebreck; 105, Oppeln.

Marshalling Yards with a capacity exceeding 2,000 wagons per 24 hours

No. on maps	Yard	Capacity
	Augsburg R.B.D.	
3	Augsburg	2,300
	Berlin R.B.D.	
7	Lichtenberg-Friedf.	2,700
8	Nieder-Schonweide	3,500
9	Pankow	2,700
11	Rummelsburg	2,700
13	Seddin	2,400
14	Tempelhof	2,900
15	Wustermark	5,000
	Breslau R.B.D.	
26	Breslau-Brockau	5,000
35	Dittersbach	2,000
84	Kohlfurt	2,200
113	Schlauroth	2,400
	Dresden R.B.D.	
28	Chemnitz-Hilbersdorf	3,500
43	Dresden-Friedrichstadt	4,000
90	Leipzig-Engelsdorf	3,700
91	Leipzig-Wahren	4,500
	Erfurt R.B.D.	
50	Erfurt	2,600
61	Gera	2,000
62	Gerstungen	2,000
128	Weissenfels	2,400
130	Zeitz	2,600
	Essen R.B.D.	
21	Bochum-Riemke	2,200
34	Dalhausen	3,600
36	Dortmund	4,800
38	Dortmund-Eving	2,000
40	Dortmund-Süd	2,400
42	Dortmunderfeld	3,000
46	Duisburg Hbf.	3,600
51	Essen	2,600
52	Essen-Frintrop	5,400
59	Gelsenkirchen Hbf.	2,000
60	Gelsenkirchen-Schalke	2,200
69	Hamm	10,000
19	Herne	2,400
89	Kupferdreh	2,600
20	Langendreer	5,000
97	Mülheim-Speldorf	3,000
102	Oberhausen-West	3,100
53	Osterfeld-Süd	6,800
47	Ruhrort-Hafen neu	5,000
116	Sinsen	2,000
22	Wanne-Eickel	5,200
127	Wedau	7,200
	Frankfurt-am-Main R.B.D.	
56	Frankfurt-am-Main	2,700
	Halle R.B.D.	
18	Bitterfeld	2,000
	Falkenberg	3,500
	Falkenberg	2,500
68	Halle	4,500
86	Kottbus	2,000
96	Merseburg	2,000
111	Rosslau	2,250
115	Senftenberg	4,000
	Hamburg R.B.D.	
70	Eidelstedt	4,000
71	Rothenburgsort	3,300
72	Wilhelmsburg	4,800
	Hanover R.B.D.	
23	Bremen	4,100
27	Brunswick-Süd *	4,000
73	Hainholz	2,100
67	Halberstadt	2,200
74	Lehrte	4,000
92	Magdeburg-Buchau	3,800
93	Magdeburg-Rothensee	3,000
76	Seelze	5,000
118	Stendal	4,500
	Karlsruhe R.B.D.	
4	Basel Rbhf.	2,400
80	Karlsruhe	3,300
94	Mannheim	7,000
104	Offenburg	3,200
	Kassel R.B.D.	
65	Göttingen	2,600
81	Kassel	2,300
100	Nordhausen	2,000
117	Soest	4,000
	Köln R.B.D.	
1	Aachen-West	3,000
31	Gremberg	6,000
88	Hohenbudberg	6,700
82	Koblenz	2,600
29	Köln-Eifeltor	6,000
30	Köln-Gereon	2,000
32	Köln-Kalk-Nord	4,500
33	Köln-Nippes	3,500
87	Krefeld	2,000
45	Neuss	2,200
110	Rheydt	2,500
120	Stolberg	2,000
	Königsberg R.B.D.	
85	Königsberg	2,200
	Mainz R.B.D.	
16	Bingerbrück	2,000
17	Bischofsheim	3,200
95	Ludwigshafen	2,200
103	Oberlahnstein	2,000
	Munich R.B.D.	
98	Munich-Laim	2,900
99	Munich-Ost	2,000
	Mühldorf †	

* New yard: capacity estimated. † New yard.

Marshalling Yards with a capacity exceeding 2,000 wagons per 24 hours —continued

No. on maps	Yard	Capacity	No. on maps	Yard	Capacity
	Münster R.B.D.		49	Einsiedlerhof	3,500
24	Kirchweyhe	5,000	112	Saarbrücken	6,000
	Oldenburg	2,000			
106	Osnabrück	2,100		*Stettin R.B.D.*	
109	Rheine	2,000	119	Stettin	2,500
	Nuremberg R.B.D.			*Stuttgart R.B.D.*	
2	Aschaffenburg	3,000	78	Heilbronn	2,000
101	Nuremberg	2,900	121	Stuttgart-Kornwestheim	4,000
129	Würzburg	2,000			
	Oppeln R.B.D.		122	Stuttgart-Unterturkheim	2,200
64	Gleiwitz	6,800			
107	Peiskretscham	5,000	123	Ulm	2,400
	Frankfurt-an-der-Oder R.B.D.			*Wuppertal R.B.D.*	
57	Frankfurt-an-der-Oder	2,700	44	Düsseldorf-Derendorf	2,100
114	Schneidemühl	2,500	58	Geisecke	3,000
			66	Hengstey (Hagen)	2,350
	Regensburg R.B.D.		39	Holzwickede	2,400
108	Regensburg	2,000	41	Schwerte	2,200
	Saarbrücken R.B.D.		125	Vohwinkel	2,800
48	Ehrang	4,000	126	Vorhalle	3,800

Mountain Lines

The mountainous nature of certain parts of Germany has had a great influence on the railway network, especially in the south of the country. Here, the system passes through the upland regions of Bavaria, Württemberg and Baden, and in these districts many steep gradients are encountered, while on account of the development of inland spas and holiday resorts, many of the lines with heavy gradients are worked over by main-line trains (see p. 253). Apart from these lines, there are local railways such as the Black Forest Railway and its branch, the Murgtalbahn, which have been specially constructed in order to serve mountainous regions. Although the train speeds on such lines is, of necessity, moderate, the problem of traction is of prime importance and an endeavour has been made to improve the services in mountainous districts by designing appropriate locomotives (powerful 2–10–2 tanks) and rolling stock with much reduced dead-weight. This reduction amounted to as much as 25% on corridor and local train stock, and 15% for Eilzüge stock.

Rack Railways

Germany was one of the first countries to make use of the rack on standard-guage main lines.

Baden-Höllental Railway. This line links up the Rhine (at Freiburg) with the Danube (at Donaueschingen) through the south of the Black Forest. A Klose rack was formerly used on a 4·47 mile section in order to reach 2,930 ft., though with recent electrification, the rack has been abandoned. On the adhesion section, the maximum gradients are 1 in 40, and minimum radius curves of 15 chains. On the rack section, the maximum gradient was 1 in 18, and the minimum radius, 13 chains. The 11·8-mile branch from Titisee to Seebrugg (the Dreiseenbahn), opened in 1926, runs towards the Feldburg (4,920 ft.). At Bärenthal the line reaches an altitude of 3,379 ft., the highest point attained by a standard-gauge railway in Germany. The altitudes of the stations are as follows:

	Km.	Ft.
Freiburg	0	882
Kirchzarten	7·8	958
Hirschsprung	12·2	1,834
Highest point	—	*2,930*
Hinterzarten	16·7	2,904
Titisee	19·1	—
Neustadt	22·6	2,641
Donaueschingen	47·7	—

The line is now worked both by 2–10–2 tank locomotives and by electric traction. Gradients were eased and curves reduced to allow the use of the tank locomotives.

The Ilmenau-Schleusingen (*Thüringerwald*) *Railway.* In 1904, a mixed line was built consisting of 18·6 miles of standard-gauge adhesion railway, and five sections (totalling 3·87 miles) of rakc railway, with maximum gradients of 1 in 40 and 1 in 17, respectively, and 12·5 and 10·0 chains radius. This line runs up and down two sides of a hill. Starting from 1,565 ft. above sea-level it climbs to 2,451 ft., afterwards falling to 1,214 ft.

The Prussian Harz Railway. This line of 18·9 miles was opened in 1885, and links Blankenburg with Tanne by running across two ridges. There are ten rack sections from 0·17 to 0·96 mile long with a maximum gradient of 1 in 17, and with curves of 15 to 10 chains radius on the less steep gradients. The following altitudes are reached:

	Km.	Ft.
Halberstadt	0	—
Blankenburg	11·7	348
Hüttenrode	17·8	1,565
Rübeland	20·6	1,260
Highest point	*25·0*	*1,650*
Rottenhütte	26·7	1,414
Tanne	30·4	1,509

The 0–6–2 tanks hauled 118·1 tons at 7·5 m.p.h. on the rack section, and at 15·5 m.p.h. on the adhesion section. On the rack section 2–8–2 tanks, weighing 92·5 tons, hauled 147·6 tons in 1922. More recently, 2–10–2 *Borsigs* were put on the line capable of working over curves of 7 chains radius. With the introduction of *Borsig* tanks on the Harz railway the steeper gradients may now be worked by simple-adhesion locomotives.

The Bavarian Wegscheid Line. Between Erlau (near Passau) and Wegscheid there is one mile of rack railway on which the speed of the trains is only 7·5 m.p.h.

The Reutlingen-Schelklingen Line. Between Honau and Lichtenstein there is a rack section of 1·24 miles on which the speed of the trains is only 6·2 m.p.h.

Other rack railways used for tourist traffic only. The oldest line of this type is from Degerlock to Stuttgart, which was opened in 1884. Others followed later.

The *Siebengebirgsbahn* from Königswinter (164 feet above sea-level) to Petersburg (1,096 ft.) is 0·93 mile long with a maximum gradient of 1 in 4. The *Drachenfels* line has a difference of altitude of 1,066 ft., a length of 0·94 mile, and a maximum gradient of 1 in 3·9. The *Wuppertal-Tölleturm* line has a difference of altitude of 588 ft. and length of 1·01 miles. The *St. Andreasbergbahn* (Harz) rises through 558 ft. in 1·05 miles. The *Wendelsteinbahn*, from Munich-Kufstein to Wendelstein rises through 4,325 ft.

Traction. Very little progress was made in this connexion for many years, and in most instances the original locomotives are still in use. Two German builders, the *Esslingen* works and the *Borsig* works of Tegel-Berlin, have, however, specialized in building locomotives working over exceptional gradients, and have designed some interesting examples for other countries.

German Telpher Lines

German telpher lines are noted for their speed, which averages 16·4 ft. per second on the *Kreuzeckbahn* (Garmisch), the *Wankbahn* (Partenkirchen), and the *Predigstuhlbahn* (Bad Reichenhall), all of which are in south Bavaria. The *Zugspitze*, the highest peak of the Bavarian Alps, is served by two telphers, one on the Bavarian side and the other in the Austrian Tyrol. The former climbs from a height of 8,763 ft. above mean sea-level to the Zugspitzgipfel (9,688 ft.). The length of the line is 0·45 mile and the speed 13·1 ft. per second. The Austrian telpher is one of the longest in the world

(2·09 miles), being exceeded only by the *Nebelhornbahn* and the *Patscherkofelbahn* (2·32 miles), though the *Zugspitzbahn* makes good the largest difference in altitude, (5,170 ft.). The *Nebelhornbahn* runs from Oberstdorf (2,969 ft.) to Nebelhorn (6,338 ft.). The *Fichtelberg* telpher climbs from Oberwiesenthal (Saxony) at 2,969 ft. to 3,916 ft. The *Loschwitz* telpher (Dresden) climbs from 377 ft. to 653 ft. in 0·17 mile, and the *Burgberg* telpher at Bad Harzburg from 955 ft. to 1,594 ft.

Train Ferry Services

Sea Train Ferries

In 1937, two sea-going train ferry services were in operation from German ports, both of them in Baltic waters.

(1) From Warnemünde to Gedser (Denmark).

(2) From Sassnitz to Trälleborg (Sweden).

Warnemünde—Gedser. The Warnemünde—Gedser Packet services date from 1903, but the great increase in traffic both to Denmark and the Scandinavian peninsula which developed, resulted in the substitution of a ferry service, within six years, to the detriment of the Sassnitz—Trälleborg crossing. The Warnemünde vessels made connexions by means of through coaches between Berlin, Stettin, Hamburg and Copenhagen. At Warnemünde the time taken to load a train consisting of a passenger coach, brake van, mail van and goods wagons, is 25 minutes from the time it is uncoupled. The time-tables allow 26 minutes at Warnemünde from the arrival of the train to the departure of the ferry, and 20 minutes for the incoming train. The dimensions of the vessels used on this service are as follows:

Name	Gross tonnage	Built	Length, ft.	Power, h.p.	Speed, knots	Track length, ft.
Mecklenburg	1,547	1903	282·2	2,500	12·5	426·6
Schwerin	3,133	1926	247·9	4,500	12·5	526·0

Sassnitz-Trälleborg. In order to compete with the Warnemünde service the packet service which had been in operation since 1896 was converted into a train-ferry service. The ferry *Sassnitz* was built by *Schichau* and the first crossing was made in 1909. The vessel is smaller and has a lower speed than the Warnemünde ferry boats. The loading capacity is 155 tons. This vessel has lift bridges 62 ft. long giving a maximum gradient of 1 in 40. The vessel has two tracks, a total length of 404 ft. being available: she is equipped with twin screws and a bow rudder.

On the Swedish side, connexions are made from Trälleborg to Malmö, Oslo and Stockholm, while in Germany the line is linked by D trains via Stralsund to Berlin, Stettin and Hamburg. These trains included through coaches for each class (as well as sleeping-cars from Malmö) from Stockholm and Oslo to Berlin and Hamburg. At Sassnitz 29 minutes is allowed between the train arrival and ferry departure and 22 minutes for the incoming train. Until 1937, the crossing of the strait between Rügen and the mainland from Altefähr to Stralsund (1·7 miles) again entailed transhipment by ferry except for goods wagons which made the through journey. Three ferry boats, the *Prinz Heinrich*, *Rügen* and *Stralsund*, were used. These were double-track vessels carrying a 60-ton load with a displacement of 300 tons, at 8·8 knots. In 1933, in order to speed up the service, it was decided to build a 1·81 mile dyke linking Rügen with the mainland, together with two bridges, one of 411 ft. over the Ziegelgraben and the other 1,640 ft. long over the Strelasund. The work was completed in 1937 and the journey from Stralsund to Sassnitz covered in 1 hr. instead of 1 hr. 40 min., as a result of which the timings of the international trains between Germany and Scandinavia were revised.

Lake Ferry Services

In 1898, a service of ferry boats was introduced between Lindau and Romanshorn on Lake Constance, which later became the most important European service of its kind. The vessels, which had a capacity of 16–18 wagons, were double-track paddle boats, 246 ft. long. There were also lighters for 8–10 wagons which were stern-loaders, having a displacement of from 120–140 tons.

River Ferry Services

Ferry boats were also used across the larger rivers, where the traffic at first was insufficient to allow for expensive bridging. On the Rhine, the first train ferries were contemporary with those first used in Great Britain, though only goods wagons were carried. Practically all the river ferries were loaded by means of inclined planes, the exception being the Ruhrort ferry where lifts were used. This service to Homberg was put into service in 1852, a ferry being used to tow the boats. Other ferries subsequently opened included the Bingerbrück-Rüdesheim, Rheinhausen-Holhfeld, Griethausen-Elten and the passenger-goods service from Bonn to Obercassel. A service

between Lauenburg and Hohnsdorf was introduced over the Elbe in 1868.

Goods Traffic

In 1937, the total freight carried on the German railways amounted to 499 million tons. This figure was more than three times the tonnage carried on the inland waterways of the country, and more than twice the freight tonnage carried by the whole of the French railway network in the previous year. The freight traffic has shown considerable advances in recent years—in 1936, 428 million tons were carried, and about 386 million tons in 1935.* The German railway statistics distinguish four classes of traffic: domestic traffic (inter-district imports and exports) or *Inlandverkehr*; foreign imports and exports, *Auslandverkehr*; and through-traffic, *Durchgangsverkehr*, or 'transit traffic' as it is often called. Under 'domestic traffic' local traffic (*Lokalverkehr*) is also separately distinguished (see p. 282).

Freight traffic carried on German railways, 1935–7, *including service traffic but excluding live animals* (*in thousands of tons*)

Classification	1935	1936	1937
Domestic traffic (including local traffic)	355,735	395,149	442,576
Foreign traffic: exports	16,867	17,721	22,345
Foreign traffic: imports	12,621	14,031	15,911
Through traffic	1,325	1,056	1,412
Total	386,548	427,957	482,244

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937*, Heft II, p. 5 (Berlin, 1938).

Of all goods carried, the domestic freight accounts for 92%. The increase in freight traffic in later years has been confined principally to domestic traffic, the sphere in which railway freight predominates, both in Germany and in the systems of most other countries, the share of foreign traffic and through-traffic being but a small fraction of the total.

Principal Commodities Carried

The commodities handled by the German railways are classified into over one hundred categories, either of single commodities, or groups of related commodities. Nearly two-thirds of the total freight was composed of solid fuels and ores, while earth, sand, gravel, rough and worked stone, cement and mortar, sugar-beet, potatoes, and petroleum derivatives, formed the bulk of the remainder.

* These figures include service traffic but exclude live animals.

Fig. 62. Daily rail movement of freight, 1927

Based on official sources.

The scale in the insets is the same as the scale on the general map; the traffic on the dotted lines in the insets is shown on the general map and *vice versa*. The lower inset shows the traffic on the lines of the Essen R.B.D.

B Berlin; Br Bremen; Bs Breslau; Ch Chemnitz; DgH Duisburg-Hochfeld; DgR Duisburg-Ruhrort; Du Düsseldorf; E Essen; F Frankfurt-am-Main; H Hamburg; Ha Halle; Hr Hanover; Hrn Haltern; K Köln; Kl Kassel; Ks Königsberg; L Leipzig; M Munich; Mg Magdeburg; Mn Ludwigshafen-Mannheim; Mz Mainz; N Nuremberg; S Stuttgart; Sn Stettin.

The importance of the various traffic flows had not greatly changed between 1927 and 1939.

Goods Traffic on Leading Railway Systems

	Year	Goods Traffic (million tons)	Ton-km. millions	Length of line (km.)
U.S.A. (1)	1937	921·3	526,495	378,800
Germany (Reichsbahn)	1937	499·0	79,757	54,556
U.S.S.R.	1936	484·2	332,500	85,200
Great Britain (2)	1937	301·9 *	30,061	32,316
France (seven large networks)	1936	230·2	†	42,493
Japan (3)	1935–6	109·2 **	14,597 **	24,128
India (3)	1935–6	88·3 **	33,609 **	69,390
Belgium (S.N.C.F.B.)	1937	73·1 ***	6,230 ***	4,844
Canada	1936	68·8 **	38,564 **	68,481
Czechoslovakia S.R. (4)	1936	68·5	8,563	13,506
Poland (5)	1936	57·9	17,905	17,961
Italy S.R. (6)	1936–7	51·7 ****	11,155	16,899
Sweden (7)	1937	47·5	5,748	16,783
Argentina	1935	45·3	11,904	40,009

From *Statistisches Jahrbuch, etc., 1938*, pp. 104*–7* (Berlin, 1938.)

(1) Class I railways, i.e. railways with more than 1 million annual operating revenue; 1 June to 31 May.
(2) Excluding L.P.T.B. railways.
(3) 1 April to 31 March.
(4) Including jointly-managed private railways. Figures are annual averages.
(5) State standard-gauge lines (*Staats-Vollspurbahnen*).
(6) 1 July to 30 June.
(7) 'Railways of general importance.'
† The ton-kilometrage in 1935, when the goods traffic amounted to 220·7 million tons, was 31,316 millions.
* Not including service goods traffic or cattle.
** Not including service goods traffic.
*** Complete wagonloads. Not including service goods traffic.
**** Not including cattle.

Chief commodities carried by rail, 1937, 1929 (*in thousands of tons*)

Commodity	1937	1929
Coal	104,206	93,840
Stone	44,476	39,802
Earth, sand, gravel	37,186	31,476
Lignite briquettes	35,645	41,487
Lignite coke	29,914	29,995
Lignite (raw)	18,251	20,956
Iron and manganese ores	14,308	7,228
Sugar-beet	8,777	6,289 (1935)
Hard coal briquettes	5,708	4,912
Potatoes	5,270	4,135
Cement and mortar	9,610	7,418 (1935)
Iron and steel (rods, bars and shaped)	7,025	5,741 (1935)
Petroleum derivatives	8,962	7,107

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937*, Heft II, pp. 3–4.

Solid fuels accounted for 193·6 million tons of the total freight. Since 1929 some notable fluctuations are to be found. Whereas the weight of solid fuels carried by rail increased only from 190·9 to

193·6 million tons, considerably increased quantities were shipped along the waterways; while the movement of iron ore by rail doubled during the same period, the movement of ore by waterway showed no great increase. Stone, earth, sand and gravel, mortar and cement, all surprisingly important commodities in German economy, showed corresponding increases, though the advance in petroleum and petroleum derivatives is much smaller than might be expected. The only two foodstuffs entering largely into railway freight traffic are sugar-beet and potatoes, both of which exhibit corresponding increases in recent years.

Total Traffic

The Reich is divided up into 41 traffic districts (Fig. 63) for which detailed statistics are given, relating both to inter-district trade and the local traffic within each district. These districts are of value in any comparison of the trade within the railway network as a whole, though it should be borne in mind that they vary greatly in size, in density of population, and in economic geography. Their boundaries are frequently those of provincial or other administrative spheres, and eight of them are large cities. Nevertheless, these districts, either singly or in groups, serve for the study of production and distribution within the various economic regions of the country. In addition, twenty-six neighbouring foreign countries are also listed.

The total traffic, domestic and foreign, both imports and exports for each of the 41 German regions, in 1937, are given on page 280 ('local' traffic is counted under the figures for 'domestic' traffic).

From an examination of the total trade figures for each district, the superiority of the main German industrial areas becomes apparent, the total Ruhr traffic being over thrice as large as the left-bank Rhine districts, and nearly twice as great as the Saxony, Merseburg-Erfurt and Oppeln districts taken together. The railway network in the six industrial areas carries 40% of the total goods traffic (excluding through-traffic) of the country. If, however, the geographical area of the Ruhr is considered (i.e. if districts 22 and 23 are combined), this single industrial area deals with nearly 18% of the total goods traffic of the country.

Domestic Traffic

In the domestic freight traffic of the country, the Ruhr area in Westphalia again accounted for by far the greatest proportion of trade. With a domestic traffic of 68·6 million tons (excluding local

Railway Traffic in the 41 Traffic Districts, 1937 (in thousands of tons)

No.	District	Domestic		Foreign		Total (exc. through traffic)
		Outward	Inward	Export	Import	
22	Ruhr region in Westphalia	67,940	32,201	6,637	686	107,464
26	Rhine prov. l.b. Rhine, exc. (26*a*)	35,339	24,707	3,918	586	64,550
23	Ruhr region in Rhine prov.	31,312	23,229	2,592	216	57,349
20	Saxony, exc. (20*a*)	22,548	23,532	163	1,553	47,796
19*a*	Merseburg and Erfurt	27,802	19,605	137	110	47,654
13	Oppeln (Upper Silesia)	28,249	12,976	1,344	343	42,912
15	Breslau, Liegnitz, exc. (14)	19,602	15,808	644	539	36,593
27	Saarland	13,983	10,674	3,463	6,361	34,481
17	Brandenburg	15,555	17,793	42	100	33,490
11*b*	Hanover, Hildesheim, Brunswick	16,384	14,475	45	63	30,967
37	N. Bavaria	12,780	16,354	135	1,309	30,578
18	Magdeburg, Anhalt	13,069	16,815	72	35	29,991
24	Westphalia and Lippe, exc. (22)	13,841	15,853	206	78	29,978
21	Hessen-Nassau, exc. (19*b*, 21*a*)	15,539	13,250	139	130	29,058
28	Duisburg, D-Hochfeld, Ruhrort	5,725	22,102	181	82	28,090
36	S. Bavaria, exc. (36*a*)	11,995	13,909	63	434	26,401
19*b*	Thuringia	10,231	12,322	78	112	22,743
35	Württemberg and Hohenzollern	7,989	13,530	68	202	21,789
33	Baden, exc. Mannheim	9,182	8,770	592	158	18,702
11*a*	Oldenburg, Lünenburg, exc. (8–10)	6,750	11,713	34	143	18,640
16	Berlin	4,523	12,758	57	302	17,640
8	Elbe Harbours	4,582	8,311	457	750	14,100
25	Rhine Prov. r.b. Rhine, exc. (23, 26*a*, 28)	6,513	7,250	91	37	13,891
1	E. Prussia, exc. (2)	4,075	6,340	8	202	10,625
9	Weser Harbours	2,105	7,906	117	132	10,260
3	Pomerania, exc. (4)	3,383	6,375	9	17	9,784
26*a*	Köln	2,819	6,536	58	122	9,535
34	Mannheim and Ludwigshafen	4,717	3,920	101	49	8,787
31	Bavarian Palatinate, exc. (34)	3,918	4,341	88	73	8,420
4	Pomeranian Harbours	1,915	5,149	664	254	7,982
32	Hessen	3,625	3,920	41	43	7,629
20*a*	Leipzig	1,939	5,322	28	93	7,382
7	Schleswig-Holstein, exc. (6) and (8)	2,252	4,390	7	8	6,657
5	Mecklenburg, exc. (6)	1,948	3,530	4	4	5,486
36*a*	Munich	1,196	3,002	10	270	4,478
6	Harbours, Rostock to Flensburg	1,146	3,255	9	53	4,463
2	Königsberg, Pillau, Elbing	1,714	2,181	2	19	3,916
21*a*	Frankfurt-am-Main	1,366	2,278	18	53	3,715
14	Breslau	876	2,583	15	80	3,554
10	Ems Harbours	1,238	1,994	3	77	3,312
12	Grenzmark W. Prussia	911	1,617	5	33	2,566
	Totals	442,576	442,576	22,345	15,911	923,408
		442,576		38,256		
	Total	480,832				
	Through traffic	1,412				
	Grand Total	482,244				

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937*, Heft II, p. 5.

It should be remembered that such a system of regional divisions as this tends to exaggerate, in some measure, the amount of movement of commodities, for many consignments move between places a short distance apart, but located within different traffic districts. These figures exclude live animals.

Fig. 63. The *Verkehrsbezirke*: railway goods traffic districts

Based on *Die Güterbewegung auf deutschen Eisenbahnen im Jahre* 1937, Heft I, p. 3 and folding map (Berlin, 1938).

The numbers correspond to the numbers in the table on the opposite page. The forty-one districts employed in the returns of railway goods traffic consist in part of long-established political units—e.g. Baden and Württemberg, in part of *ad hoc* groupings—e.g. no. 8, Elbhäfen (Elbe ports)—and in part of the large cities—Breslau, Berlin, Leipzig, Munich, Mannheim, Frankfurt-am-Main and Duisburg. The forty-one districts are convenient, if not ideal, for the purpose of examining the movement of railway traffic. It should be noted that the boundaries are not related to those of the *Reichsbahndirektionen*. Separate returns are prepared for the goods traffic arranged under the *Reichsbahndirektionen* (see p. 291).

traffic), its domestic trade greatly surpasses both the Ruhr (Rhine province district) and the left-bank Rhine provinces. The domestic traffic of the whole Ruhr geographical area represents 35% of the total domestic trade (and local trade) of the country.

Of the 41 traffic districts, 11 show domestic balances outward. Most of these 11 districts are industrial regions, and the outward balances consist largely of coal, coke, and other fuels. The 30 districts showing an inward balance of trade are largely consumer areas of industrial products (coal being of major importance), large cities and ports, and (except for the Duisburg area, which includes the great

inland port of Ruhrort, to which coal is brought from the collieries by rail for export both within Germany and abroad), are comparatively non-industrial or mainly agricultural. The chief item in outward traffic is coal, which predominates in the rail freights of western Germany. The largest inward movement occurs in the district of Duisburg, D-Hochfeld, Ruhrort, though the Weser ports and Berlin have a slightly higher inward percentage balance. The greatest outward movement occurs in the Ruhr in Westphalia, though the district with the highest outward percentage balance is Oppeln.

Balance of domestic rail movements, 1937 (*in percentages*)

Districts with outward balance (10% and above)

No.	District	%
13	Oppeln district	40
22	Westphalian Ruhr	26
26	L.b. Rhine prov.	20
27	Saarland	17
15	Breslau and Liegnitz district	13
23	Ruhr in Rhine prov.	10

Districts with inward balance (20% and above)

No.	District	%
9	Weser Harbours	31
28	Duisburg, D-Hochfeld, Ruhrort	30
14	Breslau (city)	28
16	Berlin	27
4	Pomeranian Harbours	26
20*a*	Leipzig	26
6	Harbours from Rostock to Flensburg	26
7	Schleswig-Holstein	24
3	Pomerania	23
5	Mecklenburg	22
36*a*	Munich	22
26*a*	Köln	22
1	East Prussia	22
35	Württemberg and Hohenzollern	22

From: *Die Güterbewegung auf deutschen Eisenbahnen*, Heft II, pp. 8–130, and Heft I, pp. 6–128.

Local Traffic

Of the total domestic traffic, 144·6 million tons were distinguished as local traffic, i.e. traffic which was consigned to destinations within the traffic district in which it originated. The amount of local traffic is affected to a considerable extent by the size of the district, especially where the railway network is comparatively dense, as in Saxony, though with a smaller yet highly industrialized district, such as Oppeln, extremely high local traffic loadings may be recorded though usually the percentage of local to domestic traffic is small, especially in the case of large cities, e.g. Berlin, Frankfurt-am-Main, Leipzig. Generally, however, it is found that local traffic figures reflect to a large extent the economic characteristics of each particular district, and to some extent, the density of population, by the amounts of

perishable foodstuffs on short-distance transits (e.g. milk, in the districts of Berlin and Brandenburg).

Local traffic rail loadings (over 5 million tons), 1937 (in millions of tons)

No.	District	Local traffic
22	Westphalian Ruhr	15·7
26	L.b. Rhine provinces	14·02
13	Oppeln district	11·1
20	Saxony	10·5
15	Breslau and Liegnitz district	9·3
19*a*	Merseburg and Erfurt	8·9
23	Ruhr in Rhine province	7·9
27	Saarland	7·7
37	N. Bavaria	7·4
36	S. Bavaria	6·4
18	Magdeburg, Anhalt	6·3
17	Brandenburg	5·7
11*b*	Hanover, Hildesheim and Brunswick	5·6
21	Hessen-Nassau	5·1

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937*, Heft I, pp. 6–128.

Foreign Traffic

The total weight of freight carried by the railways in foreign trade in 1937 amounted to 38,256,000 tons, considerably less than that carried on the waterways in the foreign trade. Of the total figure, exports accounted for 22,345,000 tons. The foreign trade of the Reich exhibits marked contrasts, not only internally within the traffic districts of the country, but also externally.

Traffic of leading districts in foreign trade, 1937 (*in millions of tons*)

No.	District	Export	Import	Total
27	Saarland	3·4	6·3	9·7
22	Ruhr in Westphalia	6·6	0·6	7·2
26	L.b. Rhine provinces	3·9	0·5	4·4
23	Ruhr in Rhine province	2·5	0·2	2·7
20	Saxony	0·2	1·5	1·6
13	Oppeln district	1·3	0·3	1·6
37	N. Bavaria	0·1	1·3	1·4
15	Breslau and Liegnitz district	0·6	0·5	1·1
8	Elbe harbours	0·4	0·7	1·1

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937*, Heft I, pp. 130–267.

The foreign trade of the country is to be found concentrated not only in certain geographical districts, but also in special commodities —facts which may be explained by the distribution and nature of the heavy industry within the country. Thus of the total exports by rail from the country, over 13 million tons (more than half the total) were from the industrial areas of the lower Rhine (districts 22, 23

and 26), the great bulk of this being solid fuels and the products of the heavy iron and steel industries situated there. Other marked exporting centres were the Baltic and North Sea ports, Breslau, and Baden. The total imports by rail amounted to 15,911,000 tons, and in this section of the trade three areas stand high above the remaining districts. The Saar imported no less than 6,361,000 tons, Saxony 1,553,000 tons, and northern Bavaria 1,309,000 tons. Towards the Saar, the products were largely iron and manganese ores, basic slag, sand, gravel and gypsum; to Saxony, sawn timber, wood pulp, machinery and brown coal; and to northern Bavaria, wheat, fruit, manufactured iron and steel goods.

Of the total foreign trade, although over 14 million tons were handled by the lower Rhine alone, the most important single district was Saarland (9·7 million tons), which was also the only main district with a trade import balance (15%). The Ruhr area in Westphalia handled 7·2 million tons, the left-bank Rhine provinces 2·7 million tons, and Saxony and Oppeln, 1·6 million tons each.

Total rail traffic between Germany and foreign countries, 1937 (*in thousands of tons*)

No.	District	Imports to Germany	Exports from Germany
44	Alsace-Lorraine	4,030	3,360
45	Memelland	4	6
46	Danzig	30	14
47	West Poland	62	16
47*a*	Polish Silesia	154	80
48	Danish Schleswig	7	153
50*a*	U.S.S.R.	0	1
50*b*	Lithuania	16	17
50*c*	Latvia	141	2
50*d*	Estonia and Finland	0	0
51	E. Poland	135	32
52	Galicia	91	26
52*a*	Rumania	367	82
53	Hungary	624	401
53*a*	Jugoslavia, Bulgaria, Turkey, Greece	396	170
54	Czechoslovakia	3,745	2,868
55	Austria	860	1,036
56	Switzerland	103	1,855
57	Italy	567	2,986
58	France and Iberia, exc. (44)	2,235	2,347
59	Luxembourg	1,597	2,889
60	Belgium	248	1,440
61	Netherlands	630	2,380
62	England	2	9
63	Norway and Sweden	61	89
64	Denmark, exc. (48)	76	158
	Total	15,911	22,345

From: *Die Güterbewegung auf deutschen Eisenbahnen*, Heft II, p. 6.

Of the total foreign exports, 3,360,000 tons were taken by Alsace-Lorraine, while Italy, Luxembourg, Czechoslovakia, France, Spain, Portugal, the Netherlands, Switzerland, Belgium and Austria took practically the whole of the remainder. The bulk of the imports, however, were provided by Alsace-Lorraine, Czechoslovakia, France, Spain, Portugal and Luxembourg.

Through Traffic

Through-traffic plays a very minor rôle in German railway economy. In 1937, it accounted for 1,412,000 tons of freight.

Through-traffic districts dispatching or receiving more than 50,000 *tons,* 1937 (*in thousands of tons*)

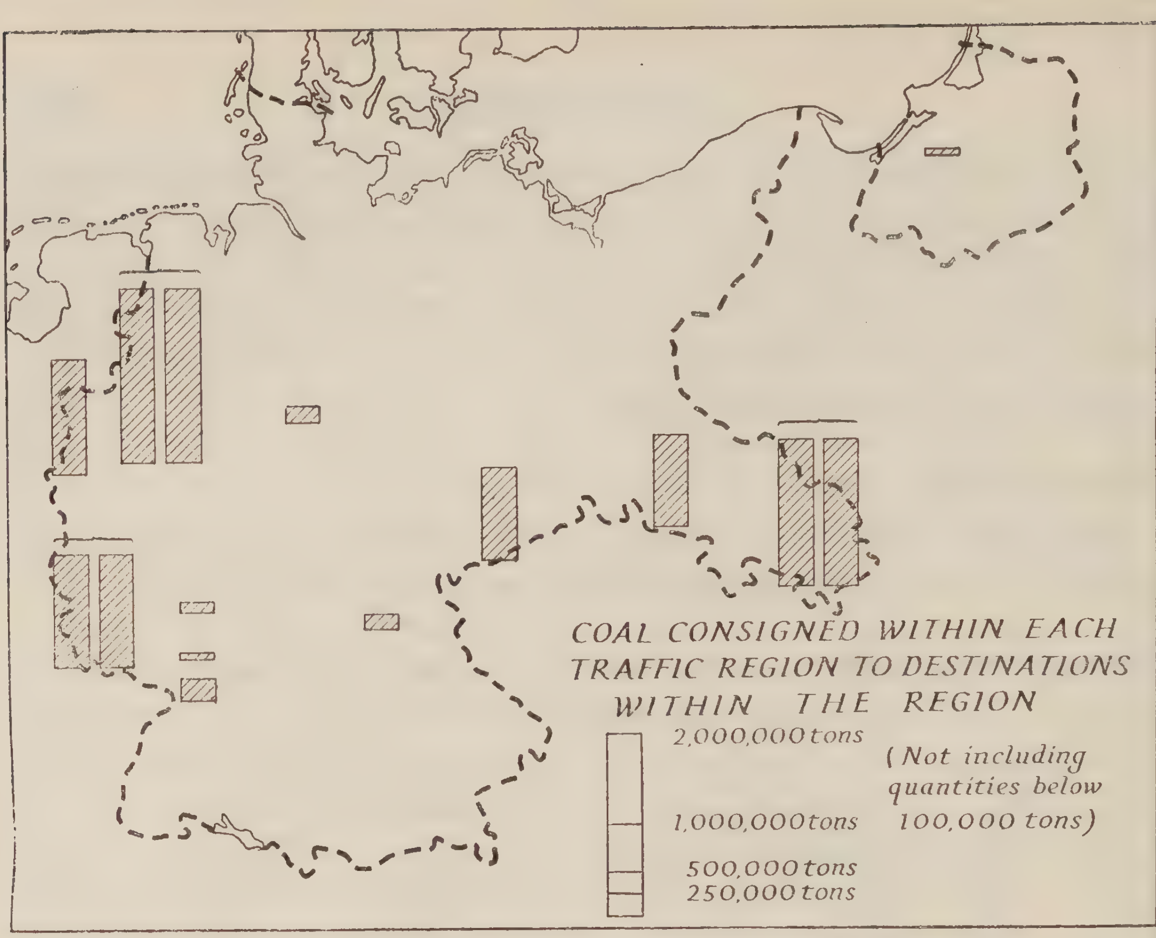
No.	District	Despatch	Receipt
44	Alsace-Lorraine	15·0	55·3
47	West Poland	54·1	15·1
47*a*	Polish Silesia	113·3	11·5
52	Galicia	58·0	1·5
53	Hungary	94·6	3·9
54	Czechoslovakia	465·2	167·6
55	Austria	103·5	129·8
56	Switzerland	56·6	406·3
57	Italy	93·4	87·2
58	France, Spain, Portugal	35·6	149·3
60	Belgium	75·3	110·1
61	Netherlands	124·7	149·7
	All districts	1,412·4	1,412·4

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937*, Heft II, p. 163.

Important commodities moving in the through-traffic were sugar from Czechoslovakia to Switzerland, coal and coke from Polish Silesia to Austria and Italy, sawn timber from Austria to France and Belgium, wheat from Hungary to Switzerland, fruit from Italy to Belgium, Norway and Sweden. Many of the commodities in the through-traffic trade are a reflection of the economic geography of the surrounding districts, but the predominance of movement towards Switzerland is marked.

Rail-Water Inter-change.

There is a considerable inter-change of traffic between the railways and waterways of Germany. In 1937, 36 million tons of goods were transferred from the railways to the waterways and canals and 15 million tons in the opposite direction. The total, however, is but a small percentage of the total rail traffic of the Reich. Approximately twice the amount of goods is fed from the railways to the waterways



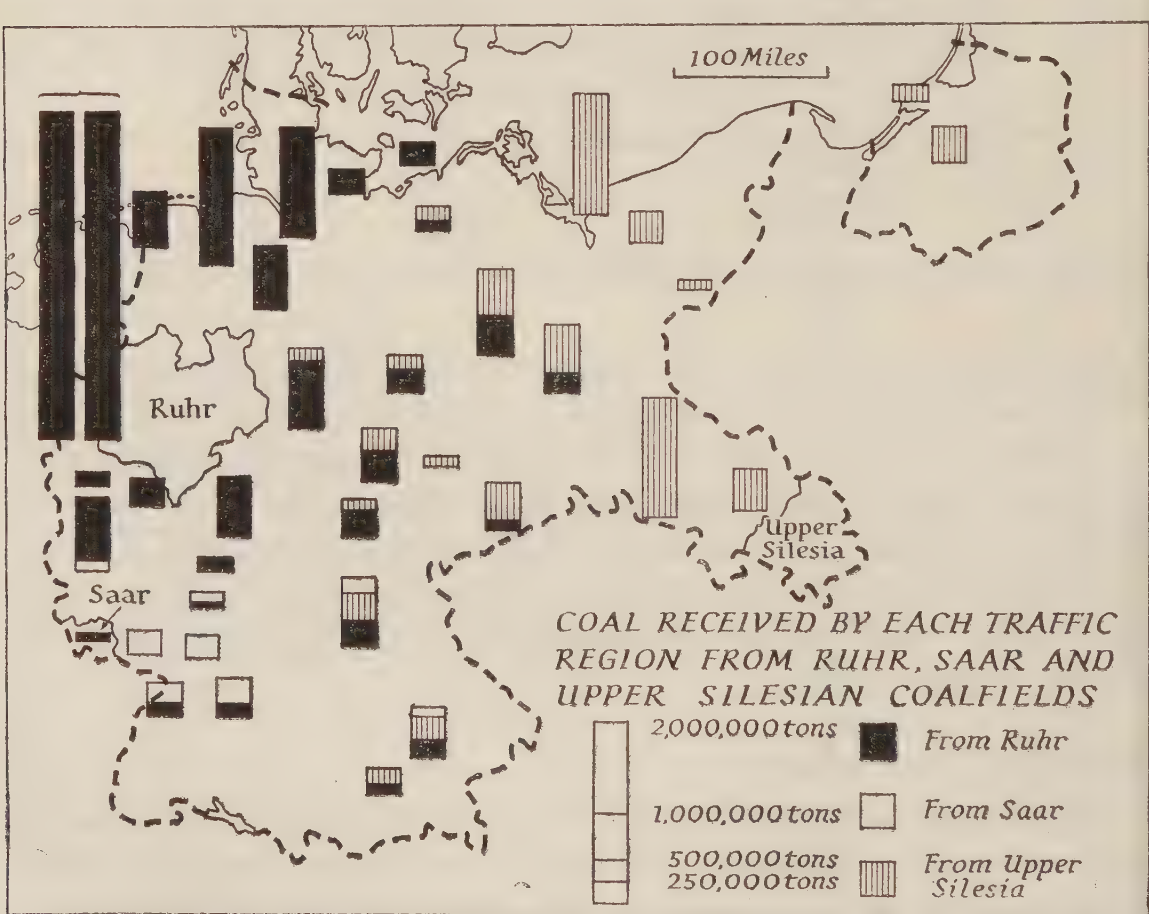


Fig. 64. Movement of coal (excluding lignite) by rail, 1937

Based on data from *Die Güterbewegung auf deutschen Eisenbahnen im Jahre* 1937, Heft I, II, *passim* (Berlin 1938).

Each rectangle is placed as nearly as possible in the centre of the traffic district to which it refers. The 'Ruhr' in this figure, in order to cover all the coal-producing districts, is a combination of the traffic districts nos. 22, 23, 24, 25. The upper diagram shows the considerable local movement of coal which occurs in each coalfield. In the lower diagram the outstanding item of nearly 20 million tons received to the west of the Ruhr represents the movement by rail from the Ruhr mines to Duisburg-Ruhrort for shipment by barge.

as in the opposite direction. This difference is due largely to the movement of solid fuels, stone, cement, sand, gravel, etc., in which the railways play a leading part (see p. 553).

Rail Movement of Certain Commodities

The movement by rail of all the 442·5 million tons which enter into the domestic trade (*inlandverkehr*) of Germany, if analysed completely, would provide an interesting commentary upon the economic geography of the country and upon problems of transport economics. The movement and direction of many items would not be unexpected, while others would offer a number of curious features. The following is an examination of several specific commodities, arbitrarily selected.

Coal. The rail movement of coal is illustrated in Fig. 64. Much more coal is carried by rail than by waterways—98·1 million tons against 43·5 (excluding coke), for the railway network penetrates the whole country, whereas the waterway network is much more restricted by relief. Nevertheless, the rail carriage of coal is not merely a matter of feeding canals from coal mines and of distributing coal at the end of a canal journey. The bulk of the rail-borne coal is in direct competition with waterway-borne coal over routes which would appear to offer the maximum advantage to waterways. Thus there is a heavy traffic of Silesian coal by rail not only to Bavaria via Hof, but also to Berlin and Stettin, and there is a considerable movement of Ruhr coal to Emden in spite of the facilities offered by the Dortmund-Ems C. (Fig. 147, pp. 14, 586).

Machinery. In the transport of machinery and plant (Figs. 16, 65) the waterway plays little part. A highly fabricated product can pay the higher tariffs of the railway, and is a more 'typical' example of a railway transported article. While certain general directions of machinery movement stand out, there is a good deal of overlapping between the principal areas of despatch, and both these and the principal importing areas receive considerable quantities from more than one centre of machinery production. These facts reflect the nature of the trade in machinery, which is an elaborate exchange of highly fabricated products. Thus a manufacturer of wire-drawing machinery in the Ruhr may import one machine tool from Stuttgart and another from Berlin. It is a trade largely of special orders and individual consignments, in which speed is of some importance, factors which make the transport of machinery hardly suited to the waterway.

Lignite. A number of commodities could be selected to illustrate

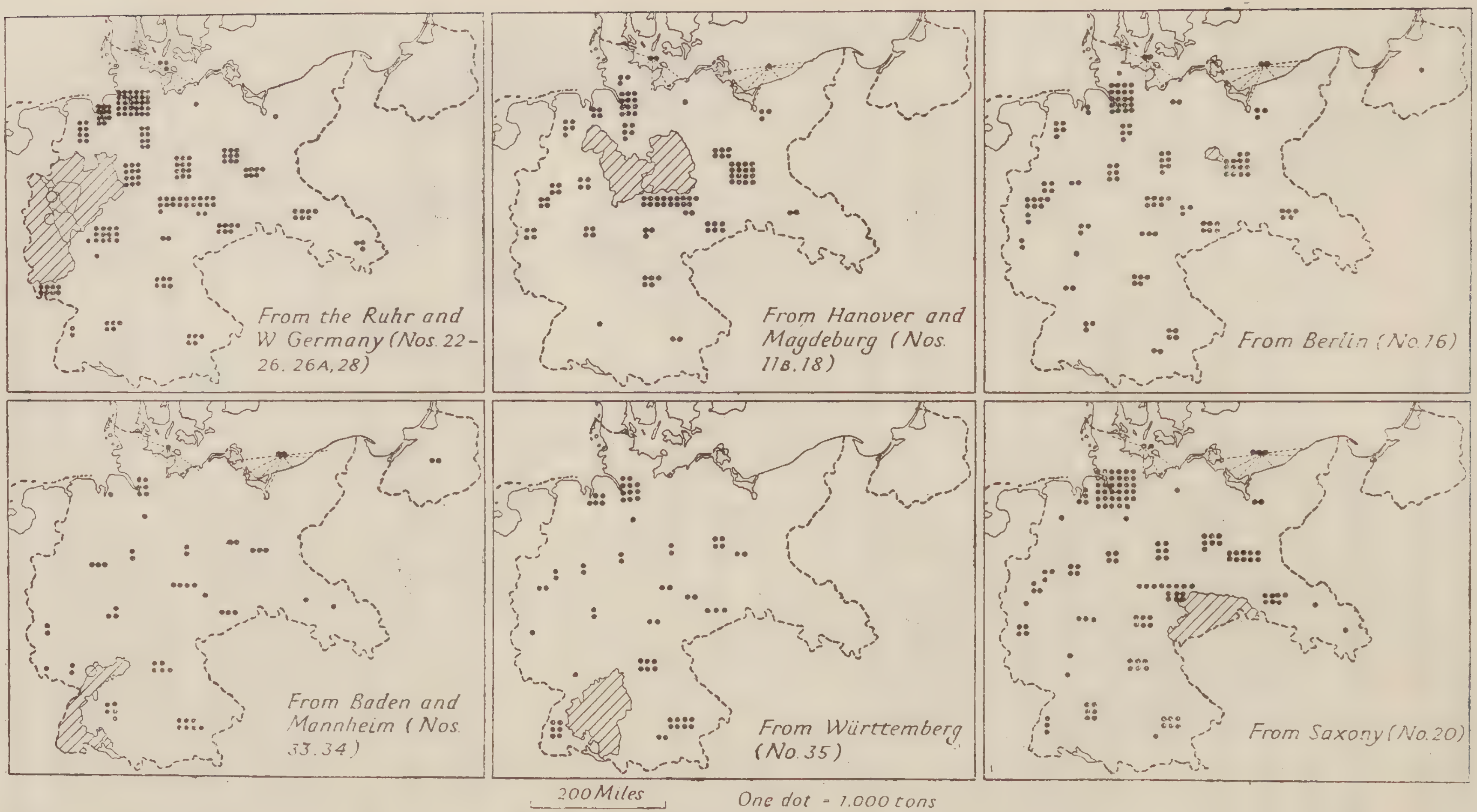


Fig. 65. Movement of machinery and plant, 1937

Based on data in *Die Güterbewegung auf deutschen Eisenbahnen im Jahre* 1937, Heft I, II, *passim* (Berlin, 1938).

The maps show the weight received by each of the 41 traffic districts from each of six principal areas of dispatch In the first map the area called 'the Ruhr and W. Germany' includes districts 22–6, 26A, 28. The symbols are placed as nearly as possible in the centre of the receiving district.

the complexity both of the economic geography of Germany and of the possibilities open to a railway system through the application of special rates. Lignite, for example, is often regarded as characteristically a fuel which can be employed economically when burnt near the lignite quarry or as a raw material for chemical industries to be refined on the spot. Yet in 1937, out of a total production of 184·7 million tons, the Reichsbahn carried 55 million tons. Of this, quantity 35 million tons were despatched in the form of briquettes, to economize in wagon space, but the remainder was raw lignite. In the same year the quantity of raw lignite and lignite briquettes despatched by waterway was little more than three million tons. Of the 55 million tons put on the rail a considerable quantity was local traffic, e.g. confined within the traffic districts of origin. Inter-district traffic was considerable, however.

Principal Lignite Movements (raw and briquette) 1937
(in millions of tons)

Traffic district	Outward movement	Local traffic
Hanover, Brunswick	1·5	0·7
Brandenburg	4·5	2·2
Merseburg, Erfurt	9·1	4·2
Thuringia	1·6	0·5
Saxony	2·8	2·0
Rhine province, L. bank	7·7	5·9

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937*, Heft I, pp. 6–128.

The greater part of this lignite entered into a traffic among the producing districts (except the Rhine province, left bank) and with the neighbouring districts of the central industrial region. In addition, Brandenburg dispatches its greatest outward tonnage to Berlin (1·9 million tons) and a million tons to all the Baltic districts, as well as 0·78 to Bavaria and Munich; Thuringia despatched 0·48 to Bavaria and Munich, and Saxony 0·29 to the same destination. The lignite of Merseburg enjoyed the widest distribution—only seven out of the forty-one traffic districts received less than 1,000 tons (including lignite coke). The movement from the Rhine province followed a different direction: of the 7·7 million tons despatched over three million tons went to Köln and the neighbouring Ruhr-Westphalian traffic districts; the remaining quantity was sent mainly to the Baltic, Hamburg and Bremen, and to the Upper Rhine and Bavaria. The Rhine province lignite field is only a few miles to the west of the river, and would appear to enjoy the best facilities for transport by waterway. Yet only 2·3 million tons were despatched in

1937, or less than one-third of the rail despatch—almost all was sent to the Lower Main and Middle and Upper Rhine districts. Over the country as a whole, only small quantities of lignite travelled by rail to the coalfields, as might be expected (except for the movement between the Rhine province field and neighbouring districts). It is the movement to the rest of the country which is of greater interest —broadly speaking, the central fields despatch lignite to a broad belt stretching from East Prussia to Bavaria. In spite of the comparative poorness of lignite as a fuel in relation to its bulk, the railways enable it to compete in the coal-less south.

Sulphuric acid. Over one million tons of sulphuric acid was carried by rail in 1937. It is a key commodity in many chemical and industrial processes, and its movement reflects the nature of the trade in basic chemicals—a high degree of inter-change within the centres of chemical industry, and little long-distance movement. Thus the Ruhr-Westphalia traffic districts exchanged a great deal with each other, and likewise the districts of Saxony and the central industrial region. In the latter, for example, the amount of inter-change was considerable; thus Thuringia received sulphuric acid from Hanover and Brunswick, Magdeburg and Anhalt, and Merseburg (6, 16 and 7 thousand tons respectively); Saxony imported as well as exported and received a small quantity from Lower Silesia; Magdeburg and Merseburg exchanged large quantities with each other. The Silesian districts formed an important source for nearby districts; Ludwigshafen-Mannheim despatched considerable quantities to south Germany.

Traffic in Reichsbahndirektionen

The Reichsbahn compiles returns showing goods traffic grouped according to R.B.D.s, returns which are not usually published. The figures for 1936 are the latest which are available. (See table on page 291.)

Seasonal variations in German Rail Freight Traffic

The freight traffic on the German railways does not take the form of a steady flow of goods throughout the year, for an examination of the monthly traffic totals brings to light a small though marked seasonal fluctuation. Moreover, whereas one might expect a maximum of traffic to be recorded during the summer months and the minimum in mid-winter, intensity of traffic is usually highest in

Goods Traffic in R.B.D.s

R.B.D.	Tonnage forwarded (millions)	Tonnage received (millions)	Wagons loaded (thousands)
Augsburg	2·0	3·1	437
Berlin	5·8	16·1	1,207
Breslau	13·1	13·1	1,465
Dresden	12·8	20·9	2,242
Erfurt	9·9	11·2	1,370
Essen	76·0	47·3	5,674
Frankfurt-am-Main	8·6	7·8	1,328
Halle	40·9	25·0	3,790
Hamburg	8·0	13·1	1,339
Hanover	19·0	27·0	3,022
Karlsruhe	10·1	8·3	1,480
Kassel	8·3	7·5	1,385
Köln	28·3	20·6	2,845
Königsberg	5·5	6·8	793
Mainz	6·4	7·7	1,076
Munich	5·0	7·2	755
Münster	6·1	9·1	1,089
Nuremberg	5·2	8·2	1,056
Oppeln	21·5	10·1	1,577
Osten (Frankfurt-an-der-Oder)	3·1	5·1	472
Regensburg	6·0	7·0	915
Saarbrücken	17·8	18·8	1,366
Schwerin	1·4	2·7	322
Stettin	6·2	12·0	988
Stuttgart	5·7	9·9	1,271
Wuppertal	16·7	20·7	1,931
Total	349·4	346·3	41,195

These figures exclude railway service traffic.
From: *Reichsbahn Handbuch*, 1937 edition.

October and November and lowest in January and February. Generally speaking, the summer and autumn months are marked by a greater intensity of traffic than the winter and spring months. This variation may be related to the bad weather which is experienced during late winter and early spring, to the movement of harvest products, and to the accumulation of quarried products in the late summer months. In 1937, 19·4% of the total traffic for the year was carried during October and November, and only 13·8% during January and February. In 1936, the percentage for October and November was the same, though for the other two months it rose to 14·3. In 1935 this seasonal traffic was even more marked, 20·2% being handled in October and November, and 13·8% in January and February. In the same year, 54·7% was handled from July to December as compared with 45·3% from January to June. The monthly figures for 1937 were as follows (in millions of tons):

Month	Weight	Percentage of traffic for the year
January	33·3	6·9
February	33·3	6·9
March	37·1	7·7
April	39·5	8·2
May	35·7	7·4
June	40·0	8·3
July	42·4	8·8
August	42·0	8·7
September	42·0	8·9
October	46·8	9·7
November	46·8	9·7
December	42·4	8·8
Total	482·2	100·0

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1937*, Heft II, p. 6.

Railway Freight Rates

As the German railway system is state-owned the rates structure tends to be influenced by national policy as well as by purely economic considerations. The method of applying rates, furthermore, differs from the method employed in Great Britain. In Germany separate rating systems are in operation for (*a*) wagon-load traffic, and (*b*) traffic in part wagon-loads, and further, according to whether the traffic is conveyed by (1) ordinary goods trains, (2) express goods trains, (3) accelerated express goods trains. The ordinary rate classification applies only to wagon-load traffic; there is no classification for part-load traffic, which is charged according to freight tables based on weight and distance. Wagon-load rates apply to wagon-loads of 15 tons and upwards, and are increased by fixed percentages, varying with the class of goods, for wagon-loads of 10 tons and 5 tons respectively. All haulage rates taper downwards with increase in distance.

Exceptional Tariffs

A considerable number of exceptional tariffs exist, but these are not always special rates as usually understood, i.e. rates applying to certain goods and to certain areas. There is a considerable number of exceptional tariffs in favour of certain commodities from all stations to all stations in Germany. Some of these so-called special rates have a general application and thus function merely as a new classification added to the general tariff. Thus, there is a raw materials tariff for bulk commodities such as fertilizers, potatoes, minerals, etc. These general exceptional rates have no quantity restrictions and are available to and from all stations in Germany.

In addition to these general exceptional tariffs, there are many

special exceptional tariffs which may be regarded as genuine special rates, i.e. rates applying to certain goods and to certain areas. These rates are subject to a number of restrictions over and above those which would apply to the same commodity when despatched at the normal rate. The employment by a trader of a given special exceptional tariff is usually dependent upon the observation by him of certain attendant clauses. An example is the 'producer' clause: when this is imposed the goods for despatch must have come from a particular country, district or town. This clause is generally imposed as a discrimination between home products and imported goods, but is also employed to aid the development of an industry in an area unfavourably situated geographically. When the clause 'prohibiting re-export' is applied, goods are given a reduced rate to a particular foreign country on the understanding that once the goods have reached their destination, they will not be re-consigned elsewhere.

Exceptional tariffs were introduced on the German railways as part of a policy which aimed at adjusting the cost of transport so as to benefit the country as a whole by assisting industry and trade against foreign competition, and by developing exports. The canals of Germany made necessary the introduction of certain exceptional tariffs, and in recent years the problem of road competition has had to be dealt with (see p. 479).

The exceptional tariffs in force on the German railways may be divided into two main categories.

Assistance exceptional tariffs. These were introduced in order to favour economic activities within Germany. They facilitate (1) the transport of vital goods within the country, (2) the penetration inland of imported goods, (3) the movements of exports from their place of origin to the seaport, (4) the protection of home markets. They overcome temporary disadvantages by emergency measures, e.g. they permit the granting of rebates to retain the custom of traders near a frontier, who could obtain cheaper rates by using a foreign railway.

Competitive exceptional tariffs. These tariffs are designed to prevent any undue trespassing within Germany of foreign transport systems which can offer lower rates for exports and imports—seaports, railways, waterways, air or road transport. A prominent example of such tariffs is the *Seehäfenausnahmetarife*, which have exerted a powerful influence in diverting to Bremen and Hamburg from Antwerp and Rotterdam the traffic of western Germany, and which have to some extent diverted from Antwerp, Rotterdam, Marseilles, Genoa and Trieste the traffic of south Germany and Switzerland.

The Reichsbahn has, in the past, justified the use of its rates favouring the ports of Hamburg and Bremen by arguing that, before the war of 1914–1918, the various states within the Reich had equally favoured their own interior waterway ports, by means of special rates. These rates were applied by south German railways to favour some of the Rhine river ports, and in some cases involved a reduction of up to 20%. The *Seehäfenausnahmetarife* is on a very different scale, however, as two examples will show:

Tobacco in casks	Pf. per 100 kg.
All rail	
Bremen—Lorrach (in Baden near Basel) (791 km.)	192
Rail and waterway	
Kehl—Lorrach (152 km.), inc. cost of transhipment	221
Transhipment at Köln	20
Rhine freight, Rotterdam—Kehl	125
	366
Difference in favour of Bremen	174

Cotton	Pf. per 100 kg.
Hamburg—Augsburg Hbf. (749 km.)	390
Mannheim Hbf.—Augsburg Hbf. (311 km.)	355
Transhipment at Mannheim	30
Rhine freight, Rotterdam—Mannheim	85
	470
Difference in favour of Hamburg	80

From: J. de Keuster, . . . *Hamburg, Rotterdam, Anvers*, p. 16 (Anvers, 1930).

The application of the *Seehäfenausnahmetarife* has had the effect of extending the hinterlands of Hamburg and Bremen at the expense of the ports in other countries. Antwerp and Trieste are most directly concerned in this rate policy.

Rates on Iron and Steel Angles, Bars, Plates, Girders and Rails (class D of the German railway freight classification) at various tariffs for selected distances, in Reichspfennig per 100 *kg. (pre* 1940*). Minimum* 15 *tons per wagon*

Selected Tariff	Distances (km.) 100	200	300	400	500
(1) Standard Rates	70	122	168	208	242
(2) Tariff 8B1:					
(*a*)	53	53	72	89	104
(*b*)	52	68	93	114	133
(3) Tariff 8B2	—	—	144	178	207
(4) Tariff 8B7	58	99	135	167	195
(5) Tariff 8G1	53	93	128	158	184
(6) Tariff 8S1	—	38	49	59	67

(1) Standard Rates.
(2) Traffic for shipbuilding or ship-repairing: (*a*) ocean vessels; (*b*) river craft.
(3) Traffic for internal use in Germany.
(4) do.
(5) Traffic for export via land frontier.
(6) Traffic for export via German seaports.

From official sources.

Iron Ore Rates, at various tariffs, for selected distances Reichspfennig per 100 *kg. Minimum* 15 *tons per wagon*

Selected tariff Distances (km.)	7	100	200	300	400
(1) Standard Rates	12	39	65	88	108
(2) Tariff 7	12	37	60	75	89
(3) Tariff 7 B4	—	—	19·8	26	31·3
(4) Tariff 7*a*	10	26	42	59	75
(5) Tariff 7*i*	—	20·96	33·86	47·56	60·46
(6) Tariff 7*b*3	7	15	23	30	36
(7) Tariff 7*b*25	8	18	27	35	42
(8) Tariff 7*b*35	—	10·4	14·5	25	28·9
(9) Tariff 7A1	7	14	22	29	35
(10) Tariff 7*g*11	—	—	19·1*	27·4*	32·4*
(11) Tariff 7G1	—	—	—	25	—
(12) Tariff 7G6	—	29	37	—	—
(13) Tariff 7*t*	10†	—	—	—	—

(1) Standard rates.
(2) Traffic for use in Germany, movement internally and from frontiers.
(3) Traffic for use in Germany, imported through German seaports.
(4) Internal traffic, mainly to Ruhr.
(5) do.
(6) Internal traffic; emergency assistance tariff.
(7) Internal traffic, mainly to Ruhr.
(8) do.
(9) Traffic for export via land frontiers or German seaports.
(10) Traffic imported via German seaports for Ruhr.
(11) Traffic imported from France and Luxembourg via land frontiers.
(12) Emergency assistance tariff: traffic imported via Aachen.
(13) Special tariff, Duisburg-Oberhausen.

* Senders of 400,000 tons per annum.

† Applicable to senders of 70,000 tons per annum.

From official sources.

GEOGRAPHICAL DESCRIPTION

The size of the country and the layout of the network present difficulties in the compilation of an adequate geographical description of the German railways. For France or Great Britain the majority of the important lines could be described in relation to the capital, but it is far from the truth to say that in Germany all railways lead to Berlin. The Rhine valley and south Germany may be regarded as comprising almost separate networks, and, nearer the capital, Leipzig is a train centre of a magnitude rarely found in a non-capital city. Further, the European express services, which make great use of the German network, leave the capital on one side to a considerable extent. The large number of important cross-routes in Germany permits the operation of a widespread and complicated timetable of inter-connecting trains—D train services (see p. 251). The im-

portance of this system, therefore, necessitates the description of many lines which do not pass through Berlin. This position is reflected in the number of provincial centres which are important junctions: thus both Köln and Düsseldorf-Neuss are entered by 11 double-track lines, Frankfurt-am-Main by 9, Mannheim-Ludwigshafen, Leipzig and Munich by 8, and Nuremberg, Halle, Dresden and Magdeburg by 7. In France the only comparable centre is Lyons, a converging point of 9 double-track lines.

In this account, for the purpose of geographical description, the country has been divided into eight regions—north-west Germany, the Lower and Middle Rhineland and west-central Germany, the Ruhr, the Upper Rhineland, south Germany, central Germany, north-east Germany, and south-east Germany. An account of each of these regions is given, including both the general features of the network found in it (physical background, operating features, engineering structures, passenger and goods traffic), and a description of certain main lines. The description of each of the main lines comprises a summary of the running features, together with a short account of the route followed. The railway facilities of Berlin are described separately (p. 413).

The networks in each of these regions are illustrated by Figs. 68, 71, 78, 80, 83, 89, 95, 97, 98. All known locomotive sheds in Germany, with the exception of a few which cannot be identified, are illustrated in these figures, and in each route summary the relevant sheds are named. Marshalling yards are illustrated in these figures, and in Figs. 60, 61, they are listed on p. 270, and are mentioned in the general account of each region, as well as in the route summaries. The great majority of the yards named have a daily capacity exceeding 2,000 wagons.

The main lines have been selected so as to include the most important railways in Germany from the point of view of traffic, international connexions, and towns served. The 'main lines' of one region connect with those of the neighbouring regions. Each line bears an index number; lines and numbers are illustrated in Fig. 66; reference to this figure, therefore, will indicate the 'main lines' which compose any long cross-country route, e.g. Bremen—Breslau, Stettin—Ulm. It should be remembered that such long cross-country routes, while they appear obvious on the map, are operated only by a limited number of trains. The capacity of the line may vary over the whole of such a route. Many sections of line are important, not because they connect two particular centres, but because

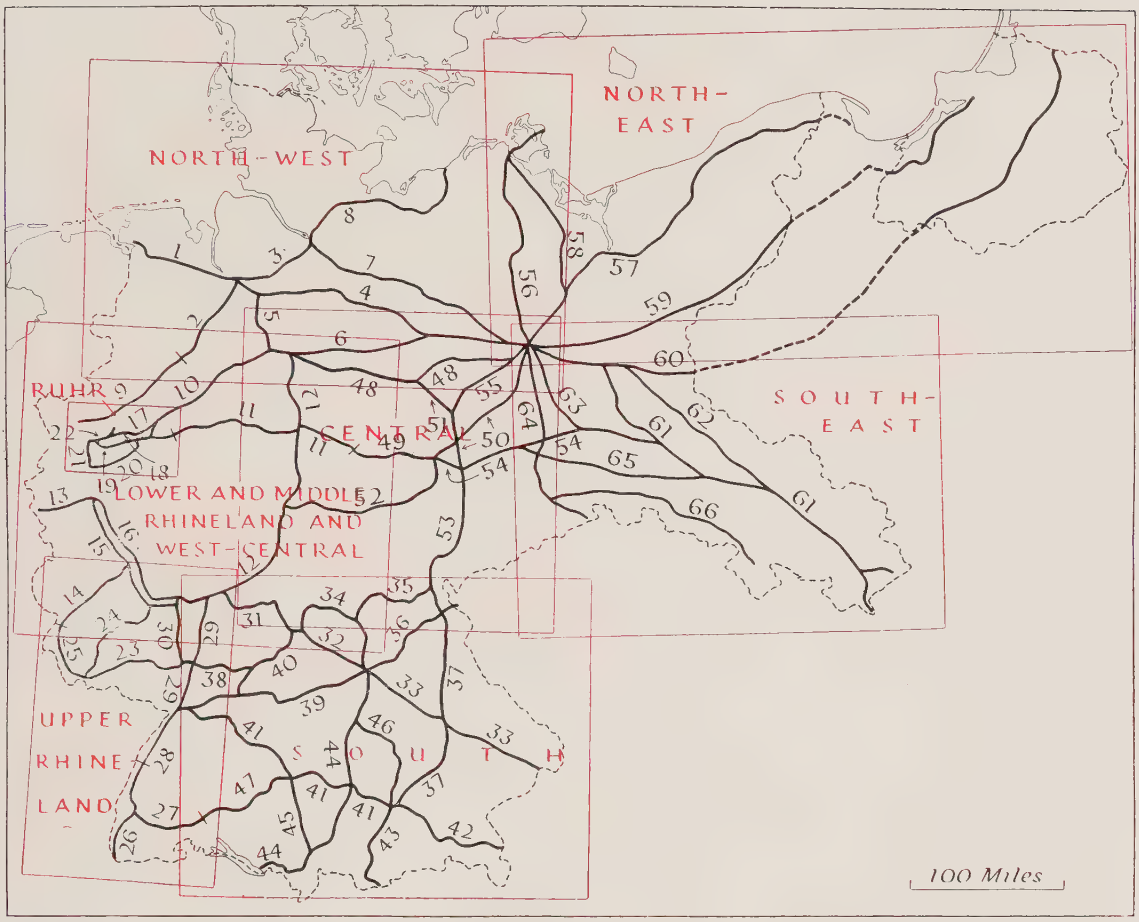


Fig. 66. Index to routes covered in the geographical description of railways

The railways shown in black are those which are described on pp. 295–412; the numbers correspond to those given to each route in the descriptions. The red rectangles indicate the appropriate maps illustrating the railways (Figs. 68, 71, 78, 80, 83, 89, 95, 97) and the names of the regions under which the descriptions will be found.

they act as links in a number of services between more widely spaced centres.

The 'capacity' is given for many of the lines described, in terms of the number of trains, and net load of trains, which can be passed along the line. The figure represents the maximum capacity allowed by the fixed and permanent facilities, assuming the availability of the necessary locomotives and rolling stock.

North-West Germany

This region extends from the Dutch frontier to Berlin and from the North Sea and Baltic coasts and Danish frontier to the southern edge of the North German Plain and of the Münster 'Bay'. The main orientation of the railway lines is from north to south, with important east-west lines through Bremen and Hanover. To a limited degree the main routes follow the direction of the Ems and Weser Lowlands, but the altitudes reached by the hills are insufficient to dominate the railway lay-out. The pattern of the network is open and sparse in the northern section of the North German Plain, but increases to the south of Hanover. On the Dutch frontier the only lines crossing between the two countries are, from north to south, at Nieuweschans, Laarwald, Bentheim, Gronau, Ahaus, Borken and Bocholt. Lines cross the Danish frontier near Süder Lugum in the west and at Harrislee in the east.

Physical Background

This region includes the western half of the North German Plain, the edges of the central uplands in the Weser Hills, and part of the 'Börderland' of Hanover—Magdeburg. Much of the area is morainic country, subdivided by the wide floodplains of the major rivers—the Ems, Weser and Elbe.

The Ems lowland can hardly be distinguished from the *Geest* of Oldenburg and Hanover on either side, but the marshy area is avoided by the Emden-Münster Railway. The *Geest* of Hanover rarely rises above 300 ft.; it is one of the most sparsely settled areas in Germany, and has a scanty railway network, with considerable distances between the stations. Rural settlement increases in density to the south. The Weser valley floodplain is much broader than that of the Ems and so it is not closely paralleled by a railway. The Lüneburg Heath, the most extensive of the *Geest* regions, attains an altitude of 560 ft.; it has a flat or undulating surface, sharply dropping to the alluvial levels on

either side. This area is thinly settled despite afforestation by the state; crossed by double-track lines from Bremen to Berlin and Hamburg and from Hamburg to Hanover and Berlin, the low productivity of the land is shown by the great distances between the stations. The Elbe valley lowlands are bounded by the sharp edges of the bounding *Geest*. The flat marshes repel railways which keep above the floodplain and rarely cross the water-logged area. The large urban expanse of Hamburg lies at a point where the two branches of the Elbe frequently run close to the sandy hills, on the southern edge of the *Geest* of Schleswig-Holstein.

Two longitudinal railways traverse the peninsula of Schleswig-Holstein—one near the west coast and one in the centre near the eastern edge of the unproductive *Geest*, where it is bounded by the hill country of Schleswig-Holstein. Linking these two longitudinal routes are several cross-lines which continue into the more fertile hill country towards the Baltic. In the east is the slightly undulating Mecklenburg Plateau crossed by countless minor rivers. Thinly peopled, with no industrial wealth, this region is marked by a sparse and open railway pattern.

In the south lies part of the 'Börderland' of Hanover—Magdeburg, sloping gently to the north. Covered by fertile loess soils, this region has several important railways linking such centres as Hanover and Brunswick. The low limestone ridge of the Weser Hills is crossed by an important railway only at the Weser Gap ('Porta Westfalica'). At the western foot of the ridge, where it drops into the plain, lies the important railway junction of Osnabrück.

Railway Divisions

This region comprises the railway divisions (R.B.D.s) of Hamburg and Schwerin and the northern three-quarters of Hanover and Münster R.B.D.s. In the Münster, Hanover and Hamburg districts there is a considerable mileage of privately-owned lines, of which the most important were four lines radiating from Lübeck and providing the shortest route between Lübeck and Hamburg.

The tracks of the R.B.D. of Münster include lines from the ports of Emden, Wilhelmshaven and Bremen to Münster, as well as the cross-line from Bentheim through Osnabrück to Hanover. These lines traverse the *Geest* of Oldenburg and Hanover to join the North Sea coast with the industrial region of the Ruhr. The railways which serve the Ems lowland follow the east bank of the river as far as Elbergen, where they cross the river and run thence to Münster on

the west bank, avoiding the unreclaimed marshy lowlands by keeping to the edge of the *Geest* country about 50 ft. above the river-level.

The R.B.D. of Hanover extends on both sides of the Weser basin as far as Hamm in the south-west, and Magdeburg in the south-east. The northern part of the district is dominated by the main routes from Bremen to Stendal and Hanover, and from Hanover to Uelzen; there are important cross-lines in the southern part of the district. This district includes the important link of two approximately parallel double-track lines between Hamm and Minden.

The R.B.D. of Hamburg reaches from Cuxhaven and the Danish frontier to Bremen, Stendal and almost to Berlin. There are parallel double-track lines from the Danish frontier on either side of Schleswig-Holstein to Hamburg, and from here lines radiate to Cuxhaven, Bremen, Hanover, Stendal, Berlin and Rostock. The R.B.D. thus crosses successively, from north to south, the *Geest* and morainic hill-country of Schleswig-Holstein, the Elbe Lowland, the Lüneburg Heath and the 'Börderland' of Hanover—Magdeburg. The R.B.D. of Schwerin extends from Lübeck to Strasburg (Oder) and from Rostock to Neustrelitz; it is therefore among the smallest of the Reichsbahn operating districts. Its lines are confined almost entirely to the Mecklenburg Lake Plateau where traffic is meagre. The district derives its main importance from the operation of the train-ferry to Denmark via Warnemünde and Gedser.

Engineering Structures

The absence of high hills has obviated the need for tunnels, but the broad lower courses of the rivers, Ems, Weser and Elbe have necessitated the building of large bridges. Such bridges are found near Emden, Bremen, and Hamburg, as well as over the Kiel C. (See page 300).

Railway Operating Features

The marshalling yards fall into two groups: several are found near the ports of Hamburg and Bremen, but the larger number form a series located at the points where the principal west-east double-track lines from Bentheim to Magdeburg and Berlin cross the north-south lines at Rheine, Osnabrück, Hanover, Hanover-Lehrte, Stendal, Brunswick, and Magdeburg. Others are situated at Münster, Bremen, Altona, Hamburg, Hamm, etc., and there is a group of such yards at Berlin (see p. 418). The railway repair workshops

Principal Bridges

No. on Map	Bridge	Over	Date built	Total length, ft.	No. of tracks	Construction
1	Weener	R. Ems	1924–26	1,100	1	1 bascule span
4	Bielefeld	Valley	1913–17	1,147	4	Concrete arches
2	Bremen-Dreye	R. Weser	1927	1,983	2	Steel spans
3	Rehme	R. Weser	1913–16	640	4	Steel spans
124	Harburg	R. Elbe	1922	2,026	4	Steel spans
125	Hamburg	R. Elbe	1926–27	997	4	Steel spans
123	Lauenburg	R. Elbe	1878	1,985	1	Steel spans
118	Wittenberge	R. Elbe	1909–10	3,379	2	Steel girders
117	Hämerten	R. Elbe	1923–26	2,690	2	Steel spans
116	Rathenow	R. Havel	1924–26	581	2	Steel spans
126	Hochdonn	Kiel C.	1919	7,277	2	Steel spans
127	Grünenthal	Kiel C.	1892	525	1	Steel span
128	Rendsburg	Kiel C.	1913	8,045	2	Cantilever steel spans
129	Levensau	Kiel C.	1894	589	1	Steel span
130	Lindaunis	R. Schlei	1924	328	1	1 span bascule
122	Niex	R. Warnow	1924	416	1	Steel girders
121	Bresewitz	R. Meiningen	1910	1,535	1	Steel spans
72	Willingen	Valley	1916–17	963	2	Concrete arches faced with stone
73	Altenbeken	Benkental	1851–53	1,425	2	Stone arches
74	Kragenhof	R. Fulda	1852–56	479	2	Stone arches
75	Witzenheusen	R. Werra	1913	378	2	Concrete arches faced sand-stone
76	Wehrden	R. Weser	1926–27	1,394	2	Steel spans

From official sources.

The location of these bridges is shown on Fig. 51.

are found at Hamburg-Gluckstadt, including works department at Harburg (locomotive and rolling stock); Lübeck; Neumünster (rolling stock); Wittenberge (railcars); Hanover (rolling stock); Osnabrück (rolling stock); Lingen (locomotives and rolling stock); Bremen (locomotives and rolling stock; wagon repairs at Oldenburg); Schwerin (locomotives and rolling stock; works department at Malchin).

Traffic

Passenger Traffic. The intensity of ordinary passenger train movement is not high on the North German Plain. The route with the heaviest traffic is Hamburg—Berlin, with about 22 trains on the line passing via Wittenberge. The Bremen—Uelzen line carries 9 trains and the Emden-Münster about 12 trains. The many cross-lines nearly all carry a sparse traffic of about 6–14 trains daily. There is fast running on lines such as those from Hamburg to Berlin or

Bremen, facilitated by the absence of important towns between terminals.

Goods Traffic. This region has a simple pattern of important freight movement: lines of heavy traffic radiate from the Ruhr to Hamburg, Berlin and Halle and from Hamburg to Berlin and Lehrte. On account of the ports some of the heaviest freight shipment in Germany over considerable distances normally takes place here.

The region includes the traffic districts of the ports of the Ems, Weser and Elbe estuaries and of the Baltic ports from Flensburg to Rostock. Inland lie the traffic districts of Oldenburg and Mecklenburg. The traffic district of Brandenburg is dealt with under 'Berlin' (see p. 419); of Madgeburg and Hanover, which overlap into this region, under 'Central Germany' (see p. 380) and of Westphalia under 'Middle and Lower Rhineland' (see p. 315). The unloadings are nearly all about twice the loadings, hence there is a considerable outward haulage of empty wagons.

Traffic, 1936 (*thousands of tons*)

District	Local	Loaded to	Unloaded from	Loaded to	Unloaded from
		other German districts		foreign countries	
Elbe ports	496	3,792	6,527	484	549
Weser ports	220	1,626	6,324	122	95
Ems ports	11	843	1,748	2	38
Oldenburg	2,274	4,161	8,476	66	74
Schleswig-Holstein	1,173	1,173	3,176	8	6
Rostock-Flensburg	130	1,008	2,752	22	40
Mecklenburg	767	957	2,385	4	4

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1936*, Heft I, II, *passim* (Berlin 1937).

The considerable foreign traffic carried on by the Elbe and Weser ports reflects the great extent of their hinterlands, which for some commodities include Austria, Switzerland and Czechoslovakia (see pp. 52, 97). Within Germany, there is a considerable rail movement of oil in various forms from the Elbe ports to the Baltic ports and Hanover, and of lignite oil derivatives to Saxony, Brandenburg, Merseburg and south Germany. Fish is sent to Berlin and iron ore to the Ruhr. Inward movements by rail include potatoes from Mecklenburg and Oldenburg, coal from the Ruhr, salt for fish-curing from Magdeburg and fertilizers from Thuringia. Malt for brewing comes from Czechoslovakia and Hungary.

The Weser ports do not handle so large a total of rail-borne traffic, but tonnage movement into them is nearly as heavy as for Hamburg. The rail traffics of the two ports present interesting differences (see pp. 50, 97). From the Ems ports (i.e. chiefly Emden) the principal items are iron ore (outward) to the Ruhr, the Saar and Oldenburg, and fuel in various forms (inwards). (See p. 14.)

Oldenburg traffic district sends out by rail potatoes to the industrial areas, fertilizers and crude mineral oil. Inward traffic comprises principally coal and fertilizers and a considerable weight of stone. In the remaining districts some of the more important items are potatoes outward to Berlin and to the ports and Ruhr coal as well as lignite and stone from central Germany moving inwards.

Route Descriptions

(1) Emden—Bremen
(2) Osnabrück—Bremen
(3) Bremen—Hamburg
(4) Bremen—Berlin
(5) Langwedel—Hanover
(6) Hanover—Stendal
(7) Hamburg—Berlin
(8) Hamburg—Lübeck—Warnemünde

(1) *Emden—Bremen*

Length: 134·1 km. (83·3 miles).
Track: Emden to km. 31·9, double; km. 31·9 to Bad Zwischenahn, single; Bad Zwischenahn to Kayhauserfeld, double; Kayhauserfeld to Oldenburg, single; Oldenburg to Bremen, double.
Maximum permissible axle-load: Emden to km. 31·9, 18 tons; km. 31·9 to Bremen, 20 tons.
Maximum gradient: 1 in 150 (minimum radius of curves, 700 m.).
Traction: Steam.
Maximum distance between stations: Neermoor to Leer, 13·6 km. (8·4 miles).
Marshalling yards: Bremen, Oldenburg, Emden.
Locomotive sheds: Bremen (3), Oldenburg (2), Emden.
Mileage datum: Emden.

The daily capacity of the line is 60–72 trains of about 450 tons net load each way except for the section between km. 31·9 and Oldenburg, where the capacity is, on account of the single line, only one-third.

The port of Emden, which has a relatively modest traffic of 7–8 million tons a year, is not well served by railways. The main line runs southwards along the valley of the Ems to Münster and the Ruhr. At km. 31·9 on this line, where the railway has crossed areas of

reclaimed marshy land with many bridges over drainage channels, the line to Bremen takes off with a reversing junction, and on the marshes of the Jümme and its tributary the Aper Tief rises to cross the low watershed to Oldenburg (88·8 km.—55·1 miles). The countryside is poor and there is little local traffic; this section is mainly single line, and the stations are all far apart. Crossing the Hunte at Oldenburg, the railway runs east-south-east across the partly afforested moorland to Bremen. Before entering the central station the railway traverses the Weser by a bridge about 350 ft. long.

(2) *Osnabrück—Bremen*

Length: 127·8 km. (79·4 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 160 (minimum radius of curves, 510 m.).
Traction: Steam.
Maximum distance between stations: Bohmte to Lemforde, 13·5 km. (8·4 miles).
Marshalling yards: Osnabrück, Kirchweyhe, Bremen.
Locomotive sheds: Osnabrück, Bremen (3).
Mileage datum: Osnabrück.

This stretch of line forms part of the principal route between the Ruhr and the ports of Bremen and Hamburg; the daily capacity is high at 72 trains of 500 tons net load each way. From the railway junction town of Osnabrück, where connexion is made with the Amsterdam to Berlin line, the railway runs through the broken country of the Weser Hills to a point near Bohmte (24·4 km.—15·1 miles). Here it turns across the Hunte valley within the *Geest* area of Hanover, where stations are far apart, and running through the wooded heathlands, descends slightly to the Weser lowlands. After crossing the Weser by a bridge about 2,000 ft. long, at Dreye (117·6 km.—73·0 miles), the railway enters the city from the south-east.

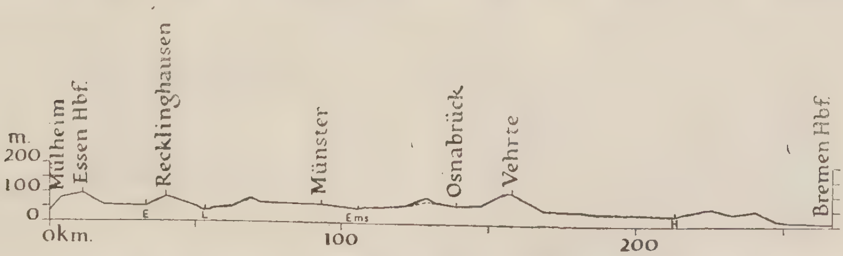


Fig. 67. Gradient profile, Mülheim to Bremen Hbf.

Based on Blum, —, 'Trassierungs-Grundsätze für Eisenbahnen ausserhalb der hoch-industrialisierten Gebiete', *Verkehrstechnische Woche*, 27th year, Heft 38, pp. 552–60 (Berlin, 1933).

E Emscher; L Lippe; H Hunte. The pecked line west of Osnabrück represents the Batis tunnel.

Vertical exaggeration approximately 100 times.

(3) *Bremen—Hamburg*

Length: 116·1 km. (72·1 miles).
Track: Bremen to Hamburg-Harburg, double; remainder, quadruple.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 100 (minimum radius of curves, 300 m.).
Traction: Steam.
Maximum distance between stations: Bremen Gbf. to Oberneuland, 11·4 km. (7·0 miles).
Marshalling yards: Bremen, Hamburg (2).
Locomotive sheds: Bremen (3), Hamburg (3).
Mileage datum: Bremen Hbf.

The daily capacity of this line connecting the two leading German seaports is high, at 72 trains each way, of 500 tons net load.

Leaving Bremen station to the north and then turning east-south-east to use the valley of the Wümme, the line runs east to Rotenburg (43·3 km.—26·9 miles) and then north-east to Hamburg-Harburg (104·1 km.—64·7 miles). The route chosen, while taking advantage of the valley to cross the low watershed between the Weser and the Elbe, in the main avoids the areas of wet meadow. At Hamburg it enters the alluvial plain of the Elbe and crosses the two branches of this river—Süder Elbe and Norder Elbe. The quadruple track is laid on two parallel bridges resting on the same piers. The bridges were rebuilt after 1920 as part of the Reichsbahn reconstruction; the length of the Süder Elbe bridge is about 2,000 ft. and of the Norder Elbe bridge about 1,000 ft. Beyond the Elbe the railway is carried by a 525-ft. bridge over the Oberhafen C. and then enters the main station. This station has only six platforms to deal with a considerable number of arrivals and departures.

(4) *Bremen—Berlin (Spandau)*

Length: Bremen to Stendal, 233·4 km. (207·1 miles);
Stendal to Berlin, 112·6 km. (69·9 miles).
Track: Double.
Maximum permissible axle-load: Bremen to Langwedel, 20 tons;
Langwedel to Uelzen, 18 tons;
Uelzen to Berlin, 20 tons.
Maximum gradient: 1 in 100 (minimum radius of curves, 270 m.).
Traction: Steam.
Maximum distance between stations:
Bergen (Dümme) to Salzwedel, 12·9 km. (8·0 miles);
Rathenow Reichsbahn to Nennhausen, 10·3 km. (6·4 miles).
Marshalling yards: Bremen, Stendal, Wustermark, Berlin.
Locomotive sheds: Bremen, Uelzen, Salzwedel, Stendal, Wustermark, Berlin.
Mileage datum: Bremen.

The daily capacity of this line is high, at 72 trains each way with a net load of 600 tons, but this line, although a trunk route, does not

Fig. 68. The railways of north-west Germany

Based on G.S.G.S. Series 4072, Europe (Air), 1 : 500,000, Sheets N.E. 54/6, N.E. 54/10, N.E. 52/6, N.E. 52/10 (1940–2), and other official sources.

'Single-track railways' include 'narrow-gauge railways'; stippled areas indicate lakes. K.W.C. Kiel (Kaiser Wilhelm) Canal.

carry a heavy freight traffic or a great number of passenger trains between Bremen and Stendal. In this section the average distance of the stations is 7·0 km. (4·3 miles) apart, a much greater distance than on many other lines in the North German Plain, and this fact alone implies that local traffic is low. From Bremen the line runs south-east on the east bank of the Weser above the flood plain. Near Langwedel (29·5 km.—18·3 miles) the line turns east and crosses the sandy area of the Lüneburg Heath, with its extensive forests. Crossing the Ilmenau, a tributary of the Elbe, at Uelzen (125·9 km.—78·2 miles) the railway turns south and then east to Salzwedel (176·3 km.—109·5 miles) on the Jeetze river and then south-east across many tributaries of the Elbe to Stendal (233·4 km.—207·1 miles). Here the line turns due east and crossing the Elbe by the 2,690-ft. girder bridge at 246·3 km. (153·0 miles) traverses the interfluve and crosses the meandering but canalized Havel near Rathenow (267·6 km.—166·3 miles) by a girder bridge 580 ft. long. Passing through the hummocky region of West Havelland the railway reaches Berlin-Spandau station on the western outskirts of the capital.

(5) *Langwedel—Hanover*

Length: 95·8 km. (59·5 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 200 (minimum radius of curves, 400 m.).
Traction: Steam.
Maximum distance between stations: Nienburg to Linsburg, 9·1 km. (5·6 miles).
Marshalling yards: Seelze, Hanover.
Locomotive sheds: Nienburg, Wunstorf, Seelze, Hanover.
Mileage datum: Langwedel.

The daily capacity of this line is high at 72 trains each way with 600 tons net load, but apart from the section from Wunstorf to Hanover neither freight nor passenger traffic is very heavy. Nevertheless, this is a valuable link between the Weser ports and the industrial area of central Germany. South of Langwedel the railway crosses the Aller river at Verden (7·2 km.—4·5 miles) and runs south between the floodplain of the greatly meandering Weser and Lichtes Moor, which forms the northern portion of the Kalenberg, to Nienburg (39·7 km.—24·6 miles). At this place the railway turns south-east and, using the river gap between Lichtes Moor and Grinder Wald, reaches Neustadt a. Rübenberge (64·0 km.—39·7 miles) on the Leine river. Keeping off the floodplain of the greatly meandering Leine, the railway follows the big loop of this river to Hanover. In the middle of the

loop is Wunstorf, the junction with the line to the Ruhr through the 'Porta Westfalica,' while on the south side of the loop is the large marshalling yard of Seelze which serves the bifurcating traffic. The railway enters Hanover by crossing the Leine just downstream of the town.

(6) *Hanover—Stendal*

Length: 154·0 km. (95·7 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 275 (minimum radius of curves, 1,130 m.).
Traction: Steam.
Maximum distance between stations: Oebisfelde to Miesterhorst, 9·6 km. (5·9 miles).
Marshalling yards: Hanover, Lehrte, Stendal.
Locomotive sheds: Hanover, Oebisfelde, Stendal.
Mileage datum: Hanover Hbf.

This line forms part of a trunk line between the Low Countries and the Ruhr and Berlin. Its daily capacity is high at 72 trains each way of 600 tons net load.

Leaving Hanover, the railway runs due east to Lehrte (13·2 km.—8·2 miles), where it crosses the Hildesheim-Celle line. Turning east-north-east, it enters the Aller valley and bridges this river at Oebisfelde (85·2 km.—52·9 miles) an important railway junction where seven lines meet. Running east-north-east across the flat area of Drömling, with bridges over six canals in 7·4 km. (4·6 miles), the railway passes through Mieste (100·4 km.—62·3 miles) to enter the hillier area of Altmark. After traversing this region it follows the Uchte valley to reach the big junction of Stendal, where eight routes converge.

(7) *Hamburg—Berlin (Lehrter Bahnof)*

Length: 294·2 km. (182·8 miles).
Track: Hamburg to Berlin (Spandau), double; Berlin (Spandau) to Berlin (Lehrter), multiple.
Maximum permissible axle-load: Hamburg to Tiefstack, passenger trains, 17–18 tons; goods trains 20 tons; Tiefstack to Berlin, 20 tons.
Maximum gradient: (*a*) Hamburg to Berlin, 1 in 526 between Reinbek (26·8 km.—16·6 miles), and Friedrichsruh (34·8 km.—21·6 miles).
(*b*) Berlin to Hamburg 1 in 500 between Büchen (55·6 km.—34·5 miles) and Schwartzenbek (45·1 km.—28·5 miles).
Traction: Steam. (Electric suburban service in Hamburg and Berlin areas.)
Maximum distance between stations: Neustadt to Friesack (13·7 km.—8·5 miles).
Marshalling yards: Hamburg.
Locomotive sheds: Hamburg (4), Wittenberge, Nauen and Berlin (Lehrter).
Mileage datum: Hamburg Hbf.

This line is one of the principal routes in Germany, carrying over 20 passenger trains a day, some of them fast railcars doing the journey in 2 hours 33 minutes. In addition, it carries more goods traffic than any other line in north Germany except one or two connected directly with the Ruhr; in contrast to such lines, however, it is characterized by an evenly balanced flow of traffic in either direction.

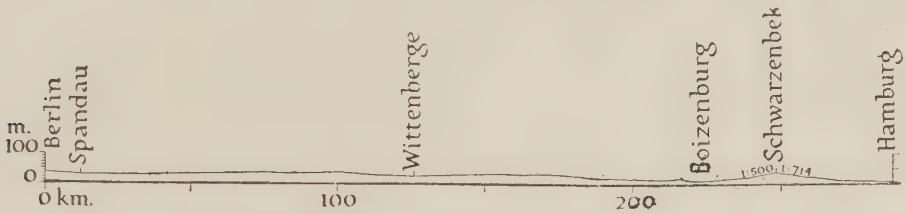


Fig. 69. Gradient profile, Berlin to Hamburg

Based on Wiener, L., 'Note on Train Speeds', *Bulletin of the International Railway Congress Association*, vol. 19, p. 2013 (Brussels, 1937).

Vertical exaggeration approximately 100 times.

With very easy gradients and curves the daily capacity of the line is high at 72 trains each way of 600 tons net load. Making a difficult exit from Hamburg Hbf. with nine bridges over streets and waterways in 2·2 km. (1·3 miles), the line curves east to avoid the ill-drained Elbe plain and rising above 130 ft. runs, in wide loops with many minor bridges over the tributaries of the Elbe, south-east to Ludwigslust (125·7 km.—78·1 miles). Here it turns and runs south-east and then south to the railway junction of Wittenberge (169·8 km.—105·5 miles). Keeping in the Elbe lowlands and avoiding the broken hills of West Prignitz, the line continues south-east. Near Friesack (232·9 km.—144·7 miles) it passes along the southern edge of the marshy area of Havelländisches-Luch and then reaches Nauen (259·1 km.—161·5 miles). Here there is a direct run into Berlin (Lehrter), a station to the north of the river Spree.

(8) *Hamburg—Lübeck—Warnemünde*

Length: 209·6 km. (130·2 miles).
Track: Double.
Maximum permissible axle-load: ?
Maximum gradient: 1 in 100 (minimum radius of curves, 260 m.).
Traction: Steam.
Maximum distance between stations: Schönberg to Grieben, 9·7 km. (6·0 miles).
Marshalling yards: Hamburg.
Locomotive sheds: Hamburg, Lübeck (?), Rostock.
Mileage datum: Hamburg Hbf.

Until 1938 the railway from Hamburg to Lübeck was still privately

owned and operated (see p. 217), although the Reichsbahn ran through-trains on it. The passenger traffic, apart from the local Hamburg services, was about 15 trains a day while the freight traffic was low. The importance of the line lies in the fact that it provides a connexion with the train ferry to Gedser in Denmark and thus gives the quickest service between Hamburg and Copenhagen. Leaving Hamburg by the suburb of Wandsbek, the railway runs up the Eilbec valley across the low watershed between the North Sea and Baltic to Bad Oldesloe (40·1 km.—24·9 miles) on the river Beste. This minor railway junction is the meeting-place with the direct Berlin to Flensburg line. Beyond Bad Oldesloe the railway runs down the valley, keeping well to the south and overlooking the old Hanse town of Lübeck. It runs east to Plüschow (109·7 km.—68·1 miles), where it turns south-east, and by crossing the valley at the north end of Schwerin See, instead of at its mouth near Wismar, is able to approach Seestadt Rostock (196·4 km.—122·0 miles) by the open valley of the Warnow instead of having to traverse the broken morainic country which lies near the coast. The small port and seaside resort of Warnemünde, set among dunes and pine forests, is reached on the west side of the lagoon estuary known as Breitling.

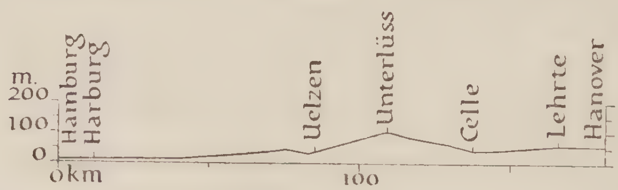


Fig. 70. Gradient profile, Hamburg to Hanover

Based on Blum, —, 'Trassierungs-Grundsätze für Eisenbahnen ausserhalb der hoch-industrialisierten Gebiete', *Verkehrstechnische Woche*, 27th year, Heft 38 pp. 552–60 (Berlin, 1933).

Vertical exaggeration approximately 100 times.

The Lower and Middle Rhineland and West Central Germany

This region is one of the most important in Germany for railway communications. Within it lies the Ruhr (see p. 324), from which many routes carry heavy passenger and goods traffic to all parts of Germany. Through it passes the great waterway of the Rhine, along both banks of which, for the most part, run double-track railways. International communications are of no less importance, and the Lower Rhine valley is the principal avenue of through expresses connecting the Channel and North Sea ports with Switzerland, Italy, the Balkans and eastern Europe (see p. 259).

Physical Background

It is convenient to regard the physical background of this region as comprising three main parts—(1) a section west of the Rhine, (2) a section east of the Rhine, both partly plain but mainly plateau areas, and (3) a section farther to the east, comprising much of the basin of the Weser and the uplands of west-central Germany. All three sections include, in the north, part of the North German Plain, which meets the plateaux and uplands along a fairly sharp line of division.

(1) *West of the Rhine.* The Lower Rhine Plain is an undulating terrain, passing into the similar country of south Limburg in the Netherlands. The watershed is comparatively near the Rhine; much of the plain is drained by the north-westward flowing Roer, a tributary of the Maas. A double-track line runs into the Netherlands via Kleve to Nijmegen, through the Gelderland Gate, keeping well to the west of the floodplain of the Rhine. This country-side presented few obstacles to railway building, except for the bridging of the Rhine. The plain, and the similar tract of the Köln 'Bay', are densely populated and served by a close network of railways.

South of the Rhine lines crossing the Dutch frontier occur, from north to south, at Kleve, Gennep, Kaldenkirchen, Dalheim and Aachen (several lines). South-west from Aachen four routes run into Belgium, while the only routes south of this into the Belgian Ardennes pass through at Losheim and Bleialf. The solitary crossing-point of the frontier with Luxembourg is near Trier, where the Mosel cuts a natural routeway between the plateaux of the Eifel and Hunsrück. At the southern tip of the Duchy a line from Trier on the east bank of the Mosel enters France at Perl. This region, where the frontiers of Germany and of four other sovereign states meet, is a key zone in the international communications of western Germany. Crossings from Germany into France are situated, from west to east, at Perl, Kerp, and (in France) Hargarten, Beninger, Saargemünd (two routes) Weissenburg, Lauterbourg.

The Eifel rises, at the highest point, to exceed 3,300 ft. in altitude. The plateau is an area of deeply incised valleys, which are followed by most of the railways which cross the region, in particular by the double-track line between Trier and Köln via Gerolstein on the plateau and Euskirchen at its northern edge against the Köln 'Bay'. To the east and south-east the Eifel is bounded by the great valleys of the Rhine and the Mosel. Each of these valleys has a gorge-like character, and each is an important corridor for railways.

The deeply incised Mosel is followed, chiefly on the north bank, by the main line between Koblenz and Trier. The Trier 'Bay' begins at Bullay, west of the gorge; it has an open landscape with a rich agriculture on the limestone scarplands, and the railway no longer closely hugs the river to maintain an easy gradient.

To the south-east, beyond the Mosel, stands the Hunsrück, a second considerable plateau mass, not dissimilar from the Eifel in height or character. It rises by comparatively moderate slopes from the Mosel. On its surface secondary lines serve the thinly populated country-side. Eastwards the Hunsrück terminates in the narrowest part of the Rhine gorge. South-eastwards, it drops fairly steeply into the valley of the Nahe; beyond lie the hills of the Rhenish Palatinate and of Rhenish Hesse. These are less massive in character than the Eifel and Hunsrück plateaux. The Palatinate area lies at about 1,300 ft. average height, but is cut deeply by the narrow valley of the Nahe river, which provides a fairly convenient corridor for a main line from Bingen to the Saar, via St. Wendel and Neunkirchen. A secondary line following the valley of the river Glan, the largest tributary of the Nahe, provides an alternative route between Bad Münster a. Stein and Homburg. The hills of Rhenish Hesse pass by comparatively easy stages into the plain of the Rhine between Mainz and Worms. The foothill zone of these uplands is highly productive, and so carries important railways.

(2) *East of the Rhine.* A great part of the terrain east of the Rhine shows, as might be expected, a correspondence of physical feature with the country to the west of it. In the north the Lower Rhine Plain east of the river merges into the Münster 'Bay'. Below Duisburg-Ruhrort the plain is almost featureless. Most of the river is dyked; there are frequent signs of earlier and more extensive meanders. Near the right bank, a double-track line runs into the Netherlands through the Gelderland Gate, avoiding the actual flood-plain of the river. Arnhem is the first important stop, from which point branches connect with most of the trunk lines in the Netherlands.

To the north-east is the Münster 'Bay' which slopes gently north and north-west, until it meets the relatively low but effective railway obstacle of the Teutoburger Forest. In the south is found the coal-field of Westphalia, across which flow the Lippe and the Ruhr. The whole area is served by a complicated set of railway tracks (see p. 325). The Ruhr valley is bounded to the south by the Siegerland and Rothaar Gebirge upland, which form a terrain not dissimilar from

that of the plateau blocks on each side of the Middle Rhine. With little wealth apart from the industrialized Wupper valley, the railways are principally single-track lines threading their way to the south-east. One double-track line, following the Lewie valley from Hagen, works its way through the valleys and ridges to reach to the iron-ore deposits of the Sieg valley. The Wupper valley carries two double-track lines. South of Siegerland is the high plateau of Westerwald with very deeply cut valleys. In the Dill and upper Lahn valleys are single-track lines constructed for the working of iron ore deposits. To the south is the high plateau of the Taunus which slopes gently up from the Lahn valley but has precipitous edges on the south and west. The poverty of the region and steepness of the slopes has handicapped the building of railways. To the south, however, the Taunus overlooks the plains of the Rhine above Mainz and of the Main around Frankfurt, low and productive territories where rail building has presented few difficulties.

To the east of the Rhine between Mainz and Worms, and lying to the north and south of the Lower Main, lie two upland districts, the Spessart and the Odenwald. On its western side the Spessart area is marked by broken and rugged country, and in the east forms a gently sloping, almost waterless sandstone plateau with a few deeply cut river gorges. Along the southern edge of the Spessart, where it joins the Odenwald, the Main river has cut a deep valley with terraces on both sides which are used by the railway between Miltenberg and Wertheim. To the north of the Kinzig valley the sandstone topography continues in the Fulda Gap between the volcanic masses of the Vogelsberg and Hohe Rhön. The Kinzig opens into the Fulda Gap, and this corridor, together with the narrow Wetterau Gap to the west between the Taunus and Vogelsberg, provide valuable routeways between the Upper Rhineland and the North German Plain.

(3) *The Weser and West-Central Germany.* The eastern slopes of the plateau blocks on the east of the Rhine are drained by the tributaries of the Weser. Over a great part of its upper basin, the Weser and its headwaters flow through an area of upland with narrow valleys known as the Hill Country of Hesse. The valleys, although narrow, are of value to the railway network, because they continue northwards from the two important gaps, the Wetterau and the Fulda Gaps, which open southwards from the head of the Weser Basin to the Lower Main and the Middle Rhine. The valleys of Hesse, therefore, serve to carry railway routes between industrial central Germany and the Middle Rhineland.

Eastwards these valleys open into the Thuringian Basin. This extensive basin, bounded to the north by the Harz and to the south by the Thuringian Forest, provides easy routeways for east-west communication despite the presence of many sandstone scarps and river gorges. Here are found the important railway junction towns of Weimar, Jena and Erfurt. The Harz, about 55 miles long and 20 miles broad, stands out above the surrounding lowlands. The slopes of the plateau, deeply cut into by rivers flowing either to the Ems or Weser, repel railways, and there is no railway across the plateau. Around the edges, however, they are more frequent, for the population attains a moderate density, a density related both to non-ferrous mining and smelting, and to the many health resorts of the region. The Thuringian Forest upland has a steep slope to the Upper Main valley with transverse valleys, a lower altitude and more resources (iron, porcelain clay, glass sands and mineral springs). There is a greater demand for railways than in the Harz area and three routes cross this upland. To the south lie the Main Scarplands which consist of low but steep limestone and sandstone ridges alternating with clay vales. West of Schweinfurt the basin consists of a limestone plateau in which the Main has incised a valley more than 600 ft. below the plateau surface. The few railways in the west follow these deeply-cut river valleys and are unable to run many branches on to the sparsely settled plateau.

Railway Divisions

This region includes the whole, or the greater part, of the R.B.D.s of Köln, Essen, Wuppertal, Saarbrücken, Ludwigshafen,* Mainz, Frankfurt, Kassel and Erfurt and parts of Münster, Hanover, Erfurt, and Nuremberg. The great number of the operating divisions is a reflection of the intensity of the network, and of the large amount of traffic handled. The R.B.D. of Essen, the smallest area of any division, is marked by the intricacy of the lines and the weight of traffic handled. The facilities of this division and of the northern part of its neighbour, Wuppertal, are described on pp. 324–7.

The R.B.D. of Köln extends mainly on the west bank of the lower Rhine, but includes the line between Köln and Koblenz on the east bank. It includes lines from north-west to south-east, crossed by international routes eastwards from Nijmegen, Venlo, Roermond and Aachen, routes which were relatively easily laid out across the Lower Rhine Plain and the Köln 'Bay'.

* Abolished before 1939.

Fig. 71. The railways of the lower and middle Rhineland and west-central Germany

Based on G.S.G.S. Series 4072, Europe (Air), 1 : 500,000, Sheets N.E. 50/6, N.E. 50/10, N.E. 48/6, N.E. 48/10, (1940–2), and other official sources.

For key to symbols see Fig. 68. The Ruhr area is illustrated separately in Fig. 78.

South of this region the R.B.D. of Saarbrücken has a more open network which is dominated by the valleys cut into the Eifel and Hunsrück uplands. The R.B.D. of Mainz, situated at the double bend where the Upper Rhine Plain ceases as the river enters the Rhine gorge, is responsible for the railways which closely follow both banks of the Rhine, and for the east-west lines on either side of the Rhine and Main, from Bingen to Hanau. This network is best developed in Rhenish Hesse and the Lower Main Plain. Eastwards these lines continue under the administration of Nuremberg R.B.D., along the Main valley. To the north and west the R.B.D. of Frankfurt links the Upper Rhineland by railways which follow the Kinzig, Nidda, Lahn and Sieg valleys round the highlands of the Vogelsberg, Taunus and Westerwald.

The country between the Sieg and Wupper valleys is covered by the R.B.D. of Wuppertal; the headwaters of the Sieg and Lenne rivers provide connexion with the Kassel R.B.D. The valley of the Fulda, on which Kassel stands, and the tributary valleys of the Upper Weser provide no great amount of local traffic, but these railway routes are of considerable importance, for Kassel R.B.D. lies at the crossing of two streams of traffic—from the Upper Rhineland to the industrial district of central Germany and from the Ruhr to Saxony.

To the south-west of Kassel R.B.D. lies the R.B.D. of Erfurt, which occupies the Thuringian Basin. In the north is the southern edge of the Hanover R.B.D. which occupies the 'Börderland' of Hanover—Magdeburg and provides important links between the north-west, Berlin and the central German industrial region.

Engineering Structures

The high altitudes, many watersheds and deeply incised valleys have demanded the construction of many tunnels. A section of line frequently consists of a series of tunnels and bridges as the railway cuts through spurs and crosses rivers to gain a more favourable course. In addition there are large bridges, particularly across the Rhine, which forms the principal water obstacle in the region (Figs. 51, 71, 117, and page 314).

Railway Operating Features

Besides the 41 marshalling yards concentrated in the Ruhr, which include Hamm, the largest in Europe, there are about 20 yards within the area covered by this account. These are situated at

Principal Bridges

No. on map	Bridge	Over	Date built	Total length, ft.	No. of tracks	Construction
5	Wesel	R. Rhine	1927	6,398	2	Steel spans
12	Düsseldorf–Hamm	R. Rhine	1910–12	2,720	{2 G. {2 P.	,, ,, ,, ,,
14	Köln	R. Rhine	1907–10	1,358	4	,, ,,
15	Köln	R. Rhine	1906–10	1,800	2	,, ,,
16	Düren	R. Roer	1928–30	256	2	,, ,,
17	Remagen	R. Rhine	1916–18	1,306	2	,, ,,
18	Haiger	R. Dill	?	300	2	Stone or concrete arch
18*a*	Kasbach	Valley	1910–11	240	2	Concrete arches
19	Au	R. Sieg	?	c. 260	2	Stone arches
21	Erbach	Nistertal	1909–10	958	2	Concrete arches
20	Engers	R. Rhine	1916–18	1,920	2	Steel spans
22	Koblenz	R. Rhine	1876–79	1,260	2	,, ,,
23	Güls	R. Mosel	1926	860	2	,, ,,
24	Eller	R. Mosel	1927	910	2	,, ,,
25	Quint	Valley	1917–22	1,870	2	Concrete arches

From official sources.
G: goods; P: passengers.
The location of these bridges is shown in Fig. 51.

nodal points like Aachen, Köln, Koblenz, Trier, Bingen, Mainz, Frankfurt, Aschaffenburg, Würzburg, Kassel, Göttingen and Halberstadt. The full importance of the Rhine marshalling points is not brought out unless it is remembered that many of these places have more than one marshalling yard; Köln, for example, has five (Fig. 72), with a total capacity of 22,000 wagons per day.

Railway repair shops are at Frankfurt (coaches); Frankfurt-Nied (locomotives); Fulda (rolling stock); Limburg (rolling stock); Darmstadt (locomotives and rolling stock); Köln-Nippes (rolling stock); Jülich (locomotives and wagons); Krefeld-Oppum (rolling stock); Opladen (rolling stock); Siegen (rolling stock).

Traffic

Passenger Traffic. This region is traversed by the express trains from northern Germany to Belgium and northern France, and from north-west Germany and the Netherlands to Switzerland. In addition, it carries the very heavy passenger traffic arising from the density of the local population. Some account of the Ruhr movements is given on p. 329. The flow of passenger trains is canalized in certain areas by the pattern of the lines which is in turn related to the relief, e.g. in the Middle Rhine valley there are invaluable north-south lines on either bank of the Rhine.

The crossings of the Rhine are limited in number and the more important (from north to south) carried in 1938 the following approximate numbers of ordinary passenger trains each way in a day:

Xanten—Wesel	8
Geldern—Wesel	10
Krefeld—Duisburg	37
Düsseldorf—Neuss	60
Köln—Köln-Deutz	108
Koblenz—Neuwied	18
Koblenz—Niederlahnstein	37
Mainz—Wiesbaden	43

Goods Traffic. In the following account the Ruhr district is omitted; its traffic is described on pp. 329–33. The main lines of traffic flow across the Middle and Lower Rhineland and all owe their importance, in some degree, to the resources of the Ruhr. Radiating from the Duisburg—Düsseldorf—Köln knot, the principal traffic lines run north to Hamburg, east to Hanover, the central industrial area, and Berlin, and south-east through the Rhine valley. There is heavy short-distance traffic to the iron-ore area of the Sieg and a secondary movement westwards to Aachen.

The traffic districts analysed below are contained almost entirely within the region, and in conjunction with the Ruhr traffic districts (see p. 331) cover the whole of Middle and Lower Rhineland. There are in the east intrusions of Merseburg and Thuringia which are considered under Central Germany (see p. 380).

The traffic districts have, even allowing for the great area of some, considerable loadings and unloadings. For the region as a whole, inward and outward movements tend to balance, but individual districts do not experience such a balance and there is, therefore, a considerable haulage of empty wagons.

Traffic, 1936 (*in thousands of tons*)

District	Local	Loaded to	Unloaded from	Loaded to	Unloaded from
		other German districts		foreign countries	
Hesse-Nassau	4,276	8,878	6,469	122	109
Rhine Prov. E. of Rhine	718	4,947	5,461	77	29
,, ,, W. ,,	12,617	20,025	9,185	3,396	538
Köln	310	2,313	5,716	50	114
Westphalia and Lippe	3,401	8,763	11,203	159	62

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1936*, Heft I, II, *passim*.

Route Descriptions

(9) Wesel—Osnabrück
(10) Hamm—Wunstorf
(11) Soest—Nordhausen
(12) Hanover—Fulda—Frankfurt-am-Main
(13) Aachen—Köln
(14) Trier—Koblenz
(15) Köln—Koblenz—Mainz
(16) Köln—Linz—Frankfurt-am-Main

(9) *Wesel—Osnabrück*

Length: 132·2 km. (82·1 miles).
Track: Double.
Maximum permissible axle-load: Wesel to Haltern, 18 tons; remainder, 20 tons.
Traction: Steam.
Maximum distance between stations: Wesel to Drevenack, 8·3 km. (5·1 miles).
Marshalling yards: Münster, Osnabrück.
Locomotive sheds: Wesel, Haltern, Münster, Osnabrück (2).
Mileage datum: Wesel.

This railway is part of a trunk line from the Netherlands to north Germany and from the Ruhr to Bremen. The daily capacity for goods traffic is high at 72 trains of 500 tons net load.

Leaving Wesel on the north side of the Lippe, the line runs eastwards through a poor country with no great density of population. At Dorsten (24·7 km.—15·3 miles) it intersects with lines from the western Ruhr industrial area and at Haltern (41·0 km.—25·2 miles) it draws in traffic from Recklinghausen. Here it leaves the valley of the Lippe and runs across a morainic area with many minor rivers and passes through Münster (82·5 km.—51·2 miles) which is sited near the river Werse. Crossing this river and the Ems, the main line runs straight north-eastwards across the plain until at Natrup-Hagen (129·1 km.—80·7 miles) the line curves to use the low pass south of the Schafberge mountains to cross the Teutoburger upland and so enters Osnabrück. At this railway junction the line here described runs at right angles over the main Amsterdam to Berlin railway.

(10) *Hamm—Wunstorf*

Length: 159·5 km. (99·1 miles).
Track: Quadrupled to Minden.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 180 (minimum radius of curves, 1,000 m.).
Traction: Steam.
Maximum distance between stations: Oelde to Rheda, 10·5 km. (6·5 miles).
Marshalling yards: Hamm.
Locomotive sheds: Hamm, Minden, Herford, Wunstorf.
Mileage datum: Hamm.

The line carries the heaviest freightage of any line in Germany. The daily capacity is extremely high with 144 trains each way of 600 tons net load.

Leaving Hamm to the north-east, this line curves round the northern side of the Beckumer Berge which rises to 173 ft. Then, crossing many tributaries of the upper Ems, the railway approaches at Brackwede (62·5 km.—38·8 miles) the narrow pass by which it crosses the Teutoburger Forest ridge. Near this pass, which is controlled by Bielefeld (66·9 km.—41·5 miles), the railway crosses a valley by a 26-arch concrete viaduct, about 1,150 ft. long. East of Bielefeld the railway follows the Werre valley in the hilly country, descends to the Weser and crossing this river by a bridge 640 ft. long at 105·6 km. (65·6 miles) reaches Minden (116·6 km.—72·4 miles) by the pass known as Porta Westfalica, between the Wiehen Gebirge and Weserkette. At Minden the line turns to the east and skirting the edge of the Buckeberge runs into Wunstorf junction where it meets lines for the north and east, or continues eastwards for Hanover and Berlin.

(11) *Soest—Nordhausen*

Length: 234·0 km. (145·4 miles).
Track: Double.
Maximum permissible axle-load: ?
Maximum gradient: 1 in 79 (minimum radius of curves, 320 m.).
Traction: Steam.
Maximum distance between stations: Paderborn to Neuenbecken, 10·0 km. (6·2 miles).
Marshalling yards: Soest, Nordhausen.
Locomotive sheds: Soest, Paderborn, Altenbeken, Ottbergen, Northeim, Nordhausen.
Mileage datum: Soest.

From Soest to Ottbergen, forming part of a direct route between Berlin and the Ruhr, this line is also part of a link for stopping passenger trains and through goods between the Halle area and the Ruhr.

Running north-east from Soest, where part of the Ruhr traffic concentrates, across left-bank tributaries of the Lippe, the line crosses the Almet river near Elsen (48·1 km.—29·9 miles) and then rises through the hilly country of Hochbene von Paderborn and crosses the Egge Gebirge at Altenbeken (69·9 km.—43·4 miles). The central summit ridge is crossed by a tunnel and the railway enters the Nethe valley, down which it drops to Ottbergen (101·3 km.—62·9 miles). At Ottbergen the line turns up the Weser valley to Bodenfelde

(128·3 km.—79·7 miles) and there, using a tributary, rises to cross the Sollinger Wald, although tunnelling is necessitated near Volpriehausen (143·4 km.—89·1 miles) before it can drop to Northeim (165·3 km.—102·7 miles), where it connects with the north-south line through Hanover. Beyond Northeim the railway ascends to another waterparting, on the southern flank of the Ober Harz and, crossing from the Oder valley to that of the Wieda, switchbacks down to Nordhausen.

(12) *Hanover—Fulda—Frankfurt-am-Main*

Length: (*a*) Hanover to Eichenberg, 128·0 km. (79·5 miles);
(*b*) Eichenberg to Frankfurt, 227·3 km. (141·2 miles).
Track: Double.
Maximum permissible axle-load: ?
Maximum gradient: 1 in 78 (minimum radius of curves, 359 m.).
Traction: Steam.
Maximum distance between stations:
(*a*) Freden to Kreiensen, 10·1 km. (6·2 miles);
(*b*) Asmushausen to Bebra, 8·9 km. (5·5 miles).
Marshalling yards: Hanover, Göttingen, Frankfurt.
Locomotive sheds: Hanover, Nordstemmen, Kreiensen, Northeim, Göttingen (2), Bebra, Fulda, Hanau, Frankfurt.
Mileage datum: Hanover Hbf.

This line, which carries express passenger trains and a fairly heavy freight traffic southwards from Hamburg and Hanover, is joined at Eichenberg by the line from Berlin. It provides a fast route between the North German Plain and the Upper Rhineland.

Leaving Hanover by the Leine valley, the line runs south and so passes from the North German Plain into the Hill Country of Hesse. In this section the railway is crossed by several lines using side valleys. With this long up-valley pull south, getting much worse south of Göttingen (118·2 km.—146·3 miles), the railway reaches Friedland (121·9 km.—75·7 miles); leaving the Leine valley it then crosses by a col on the flank of Oberes Eichsfeld into the Werra valley, throwing off a secondary line downstream to the locomotive building centre of Kassel. The main line proceeds south, partly having to follow the main meanders of the Werra. Taking advantage of the Wohra, a tributary of the Werra, the line turns and rises, with several tunnels *en route*, south-east and crossing the watershed drops by the valley of a short stream down to Bebra (118·7 km.—117·2 miles). This tributary is so short and rapid that the railway has to make a big horseshoe loop on the hillside above Bebra to maintain a workable gradient. From this important junction (Fig. 93), the railway runs south-west to Hersfeld (202·1 km.—125·5 miles) up the

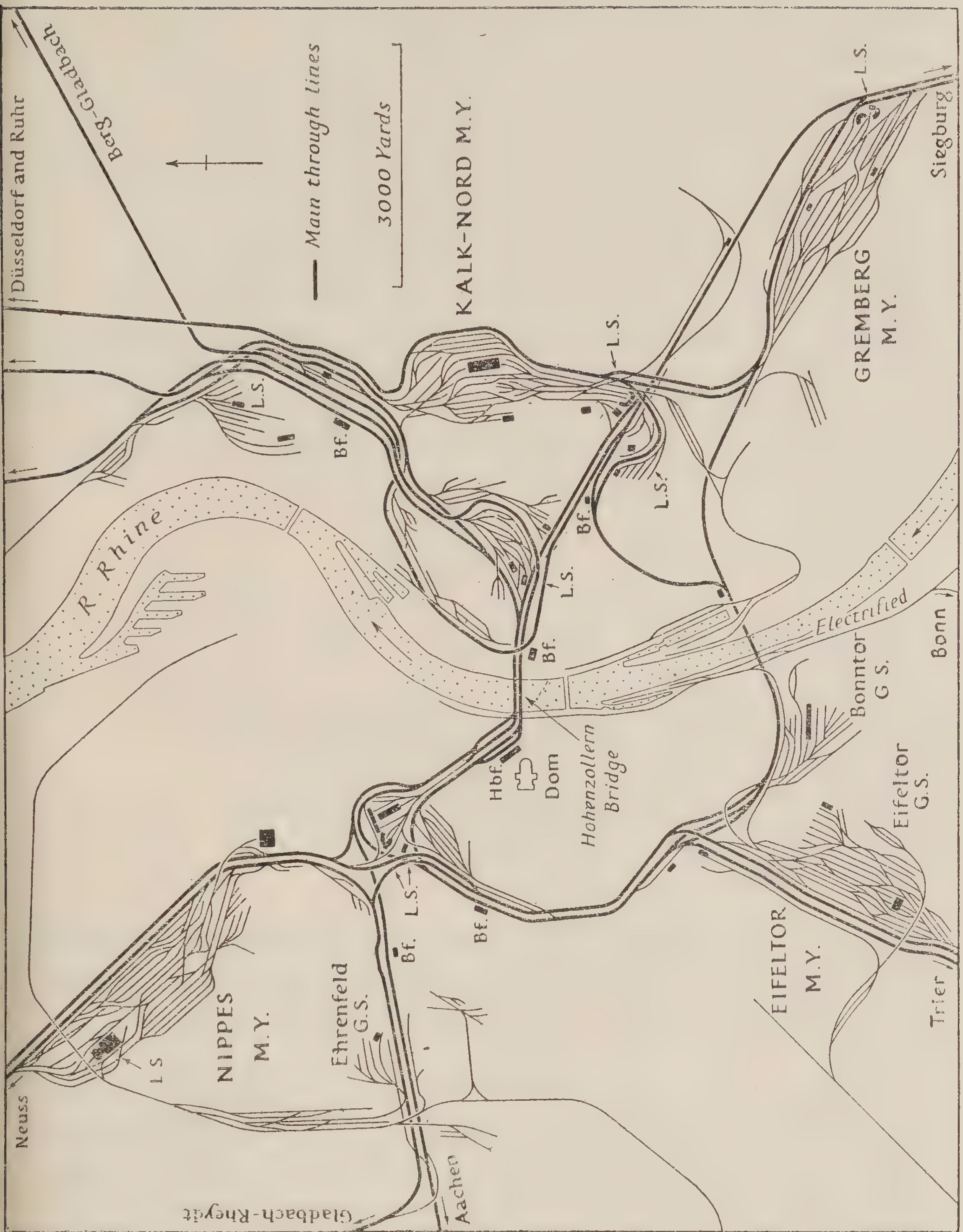


Fig. 72. The railway lay-out of Köln (Cologne)
Based on official sources.

Bf. Bahnhof; G.S. Goods Station; Hbf. Main Station; L.S. Loco shed; M.Y. Marshalling yard. The Gereon yard lies immediately to the north-west of the Hbf. The normal wagon-handling capacity of the five marshalling yards per 24 hours was: Gereon 2,000; Nippes 3,500; Kalk-Nord 4,500; Eifeltor 6,000; Gremberg 6,000. The main station, close to the cathedral, is about 20 ft. above street level, and has offices and restaurants below the platform level. The two bridges accommodate 6 tracks, of which 4 are carried on the Hohenzollern Bridge. The whole complex forms one of the most important points on the railway map of western Europe.

Fulda valley (the right-angle portion to the north-west being used by the main Erfurt to Kassel railway), and then south up the Haune tributary and rejoining the Fulda river at Fulda. By using this tributary the line avoids the narrow and incised section of the valley. At Fulda the route turns to the south-west and passes the watershed by the Elm tunnel, about 11,000 ft. long, just before Schlüchtern (220·3 km.—136·9 miles). The railway at this place is about 1,000 ft. above sea level. Considerable as the rise is, it would have been considerably more but for the existence of the Fulda Gap between the Vogelsberg to the west and the Hohe Rhön to the east. Dropping down first on one and then on the other side of the river Kinzig, the railway is easily able to keep an even grade owing to the open nature of the valley, and so passes near Hanau, with its important marshalling yard, and on to Frankfurt in the Lower Main Plain.

(13) *Aachen—Köln*

Length: 78 km. (48·5 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 38 (minimum radius of curves, 190 m.).
Traction: Steam.
Maximum distance between stations: Düren to Buir, 10·1 km.
Marshalling yards: Aachen-West, Stolberg, Düren, Köln, Gereon.
Locomotive sheds: Aachen (3), Stolberg, Düren, Köln (2).
Mileage datum: Aachen-West.

This railway gives the most direct connexion between the industrial cities of Aachen and Köln and in its western half opens up the Aachen coalfield. The daily capacity is high with 72 trains of 500 tons net load.

Leaving the frontier town of Aachen by a route running east-north-east, the railway has to tunnel by a 2,385-ft. bore between Eilendorf (12·2 km.—7·5 miles) and Stolberg (16·8 km.—10·4 miles) to enter the valley of the Inde river, and after crossing the river enters another (836 ft.) before Eschweiler station (20·2 km.—12·5 miles) in order to cross a spur. From here to Düren on the Roer river the line skirts the northern edge of the Hochwald. Crossing the river, the line runs due north-east to Horrem (57·3 km.—36·8 miles), where it crosses the Erft river. Turning more to the east, the line has to use Königsdorf tunnel for 5,315 ft. through the Ville Vorgebirge and then enters the northern suburbs of Köln, where it makes connexion with the network of this most important junction (Fig. 72).

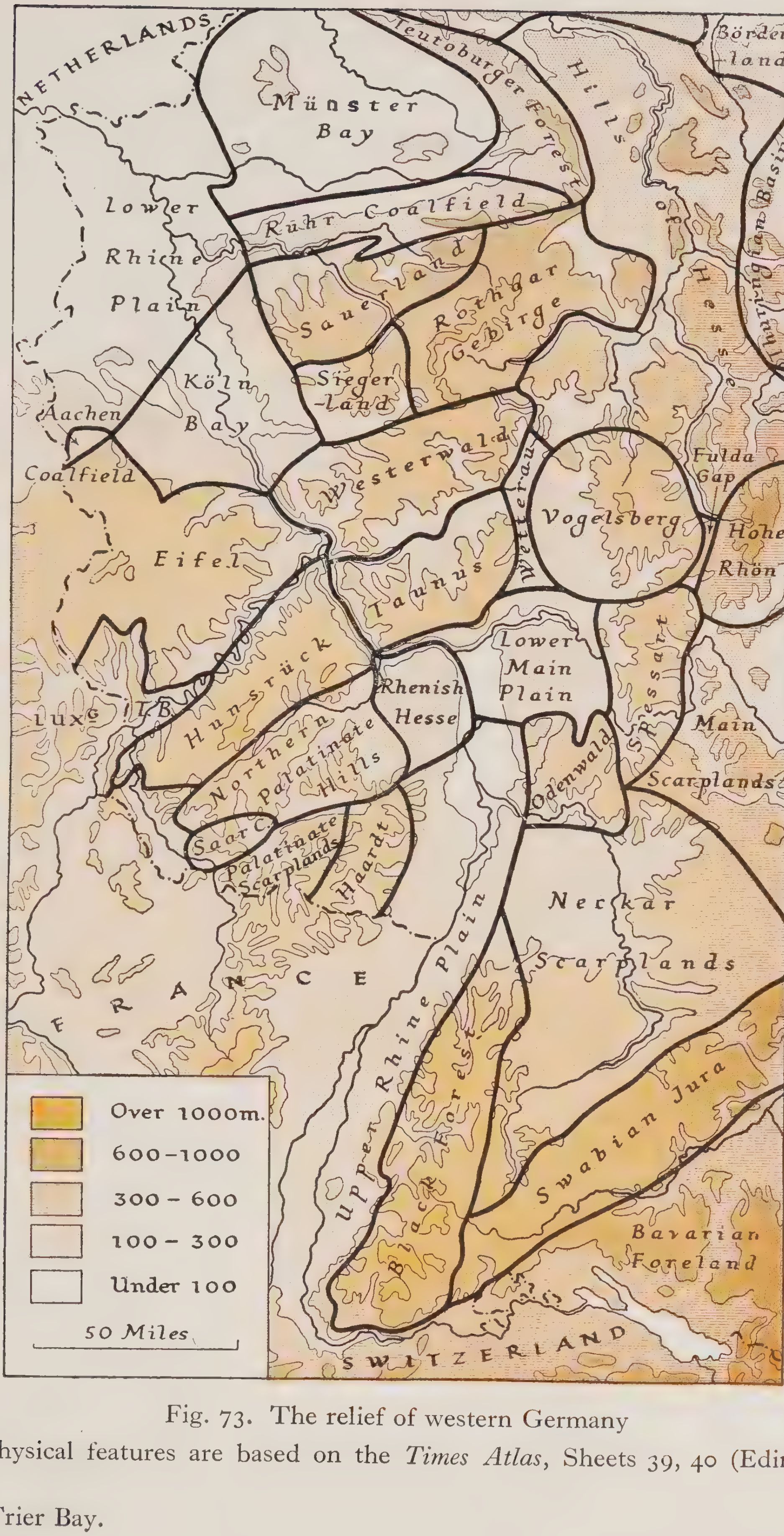


Fig. 73. The relief of western Germany

The physical features are based on the *Times Atlas*, Sheets 39, 40 (Edinburgh, 1920).

T.B. Trier Bay.

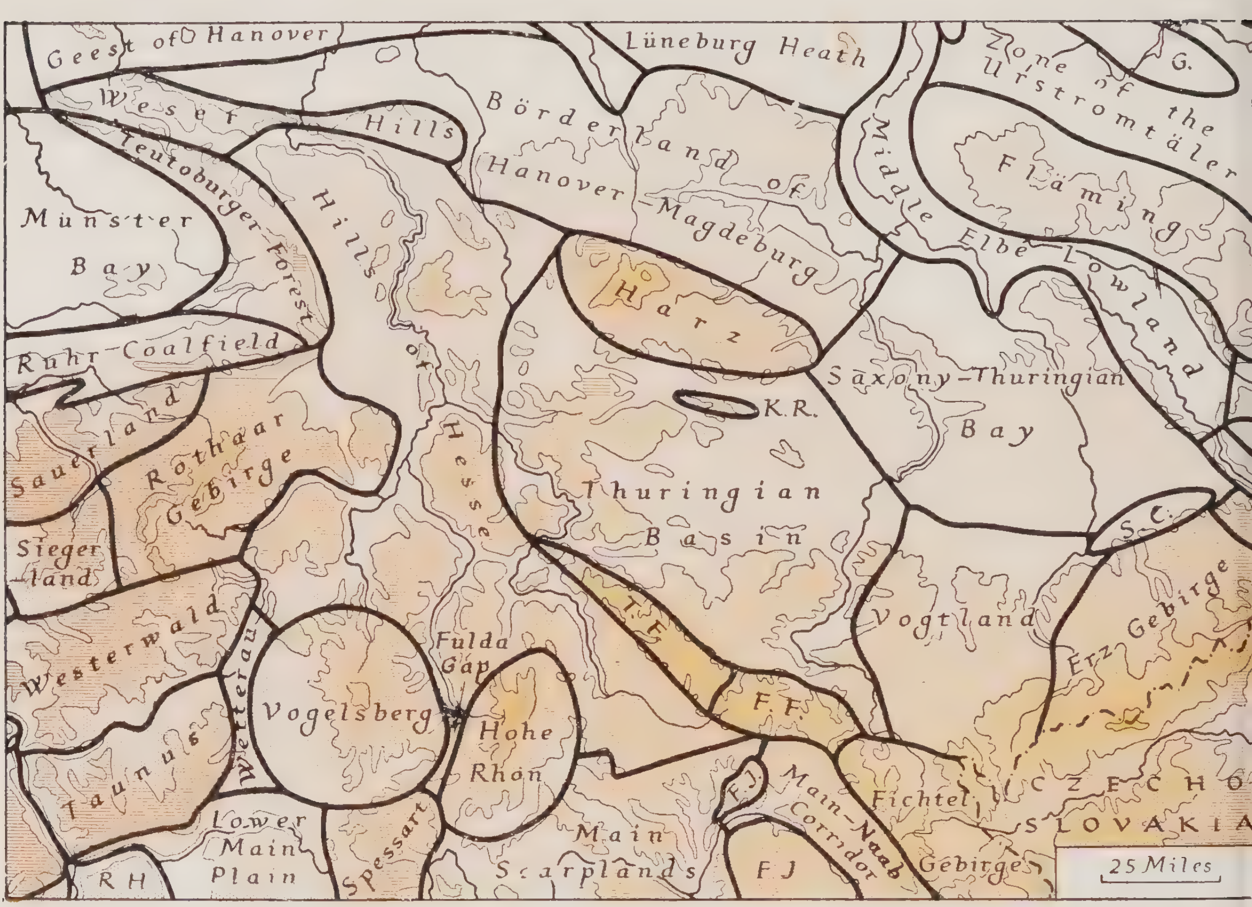


Fig. 74. The relief of west-central Germany

The physical features are based on the *Times Atlas*, Sheets 39, 40, 41 (Edinburgh, 1920).

F.F. Franconian Forest; F.J. Franconian Jura; G. Geest; K.R. Kyffhäuser Ridge; R.H. Rhenish Hesse; S.C. Saxony Coalfield; T.F. Thuringian Forest.

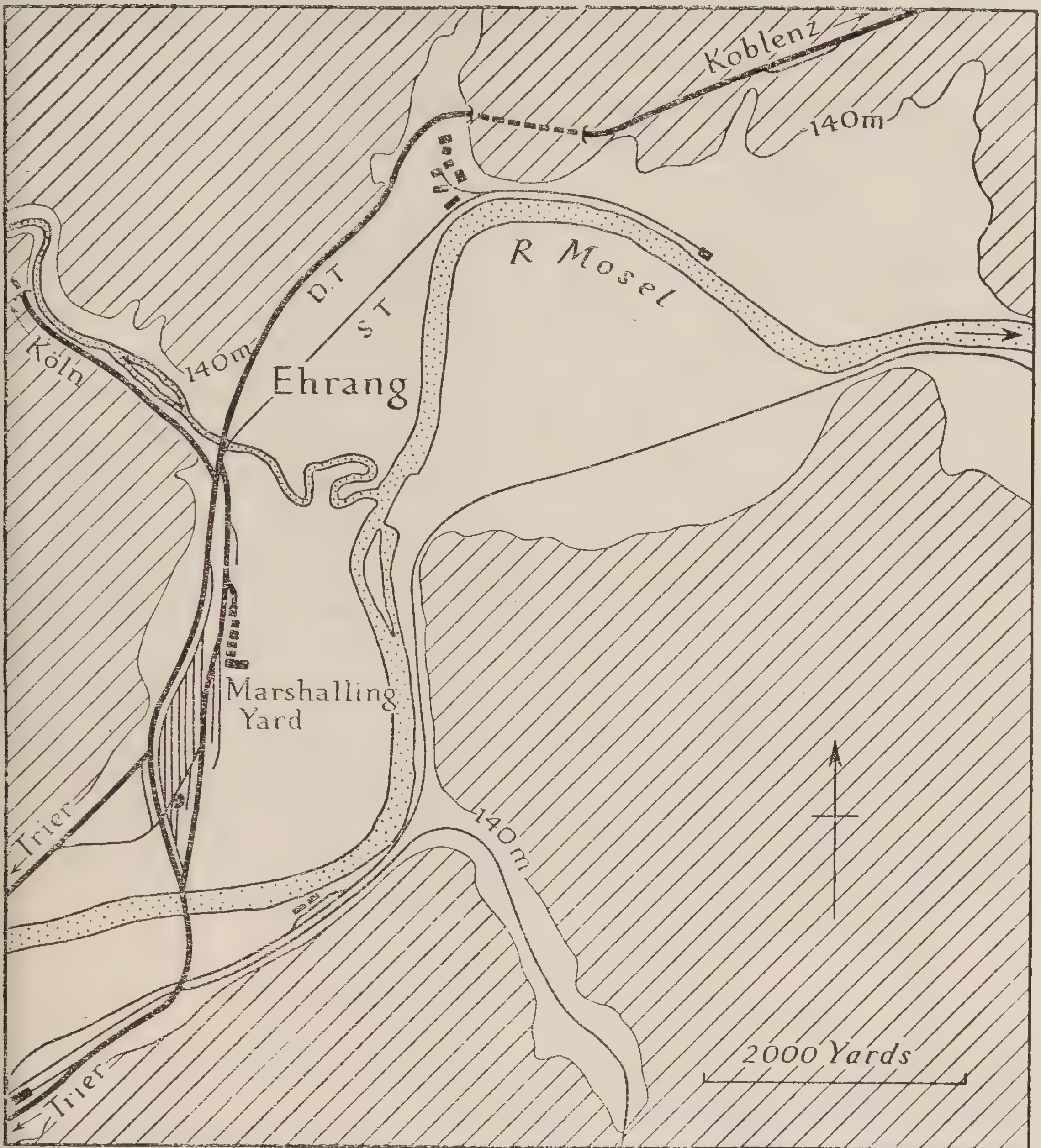


Fig. 75. Ehrang marshalling yard, near Trier

Based on G.S.G.S. series 4414, 1 : 25,000, Sheets 6105, 6106, 6205, 6206.

The deeply-incised Mosel valley is narrow through much of its length, but at this point is wide enough to permit the siting of a yard between the low ground along the river and the sharply rising hill to the west. At its widest the yard carries about 45 tracks; its normal handling capacity in 24 hours was 4,000 wagons. Trier Hbf. lies 3·8 miles south-west of Ehrang station. S.T. single track, D.T. double track.

(14) *Trier—Koblenz*

Length: 111·6 km. (69·3 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 96 (minimum radius of curves 350 m.).
Traction: Steam.
Maximum distance between stations: Salmrohr to Wengerohr, 7·5 km. (4·6 miles).
Marshalling yards: Ehrang, Koblenz (2).
Locomotive sheds: Trier, Ehrang, Kochem, Koblenz.
Mileage datum: Trier Hbf.

This line is part of the main connexion between the Saar and the Ruhr for goods movement. The daily capacity of the line is high, with 72 trains each way and a net load of about 425 tons.

From Trier the line runs on the north side of the Mosel above the floodplain as long as the valley is open. After a straight run of nearly 10 km. (6·2 miles) the railway reaches the more confined section of the valley where the Mosel is incised, and between Quint (9·2 km.—5·7 miles) and Schweich stations there are a concrete viaduct 1,870 ft. long and a tunnel nearly 3,280 ft. long, where the railway leaves the Mosel valley and takes a side valley to avoid the meandering section of the main stream. A secondary railway follows the many meanders. The line has a switchback section crossing the Salm, Leiser and other tributaries, and then at Ursig (30·3 km.—18·8 miles) there is a tunnel (1,800 ft.) cutting through the watershed between the Lieser and Alf rivers. Tunnels (2,230 ft. and 1,640 ft.) succeed at Pünderich, both cutting across the high meander 'cores' of the Mosel, whose valley the railway has again entered. From Neff to Kochem (63·9 km.—39·7 miles) the railway cuts through another meander by the Kaiser-Wilhelm tunnel, 4·4 km. (2·73 miles) long and the longest in Germany. Keeping close to the north bank of the Mosel and only needing to bridge tributaries, for the remainder of the route until the outskirts of Koblenz are reached, the railway has an easy gradient.

(15) *Köln—Koblenz—Mainz*

Length: 182·2 km. (113·2 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: Koblenz—Mainz, 1 in 165 (minimum radius of curves 375 m.).
Traction: Steam.
Maximum distance between stations: Bonn to Bad Godesberg, 6·4 km. (3·9 miles).
Marshalling yards: Köln (2), Koblenz, Bingerbrück, Mainz-Bischofsheim.
Locomotive sheds: Köln (2), Bonn, Koblenz-Lutzel, Bingerbrück, Mainz (2).
Mileage datum: Köln Hbf.

The daily capacity of this line is high, with 72 trains of 500 tons net load each way. From the Hauptbahnhof at Köln the line runs northwards on the west bank of the Rhine. The railway was relatively easy to build as far south as Koblenz (90·5 km.—56·2 miles), as only at Oberwinter (50·4 km.—31·3 miles) and Bröhl (68·0 km.—42·2 miles) is the high ground close to the river. Originally at Bonn the line was built close to the river but was later moved inland. Upstream of Koblenz is the Rhine gorge, and the railway as far south as Bingen (152·6 km.—94·8 miles) is closely confined to the bank and has to

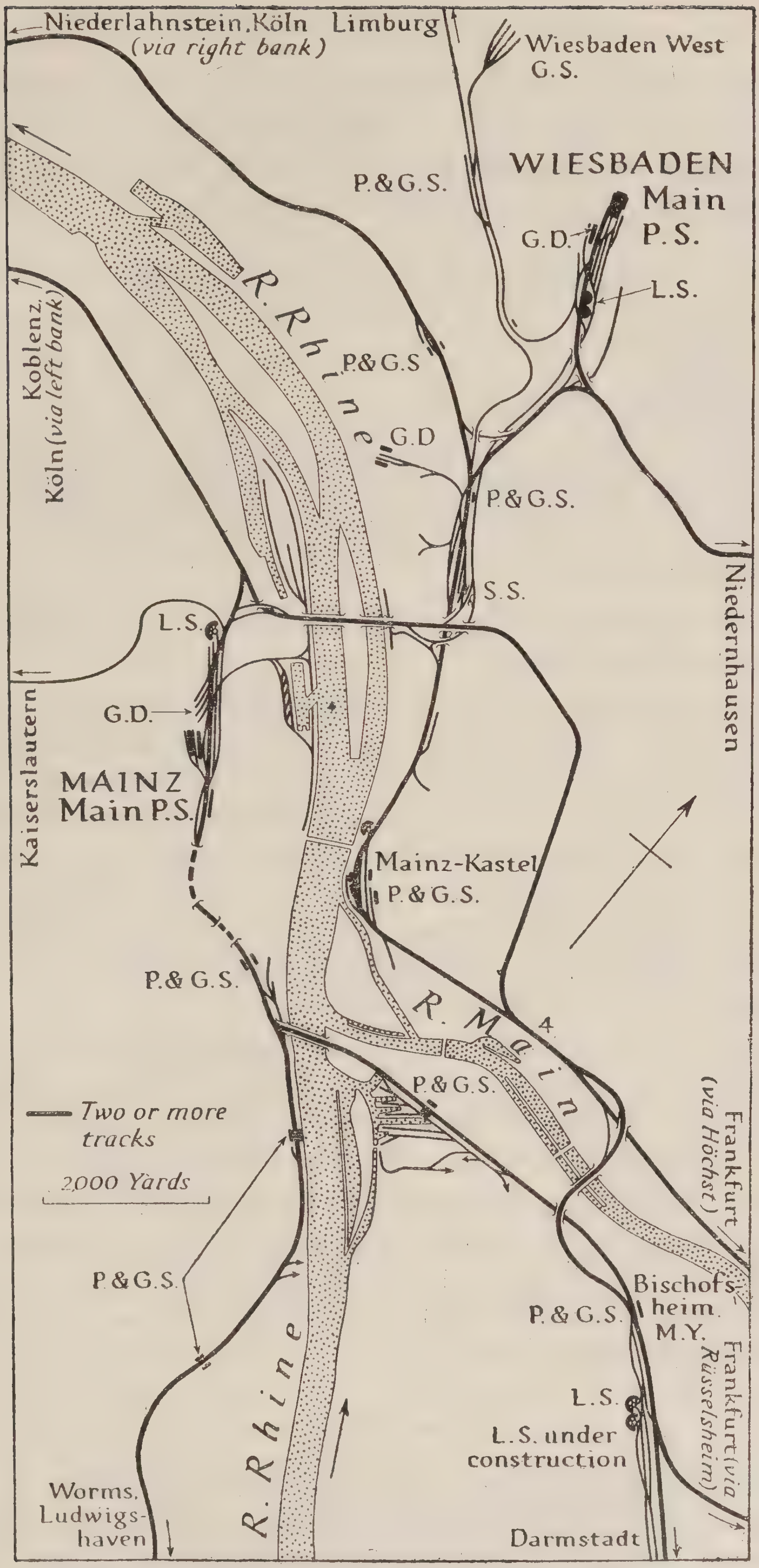


Fig. 76. Railway facilities of Mainz and Wiesbaden

Based on official sources.

G.D. Goods depot; G.S. Goods station; L.S. Loco shed; P. & G.S. Passenger and goods station. A 4-track section is shown by the figure 4.

follow the meanders of the valley, with the result that at Spay (112·7 km.—70 miles) there is a sharp left curve. At Bingen the railway sweeps inland on the inner edge of the floodplain and, at the foot of the hills of Rhenish Hesse, enters Mainz.

(16) *Koln—Linz—Frankfurt-am-Main*

Length: 224·4 km. (139·4 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Traction: Steam.
Maximum distance between stations: St Goarshausen to Kaub, 10·6 km. (6·6 miles).
Marshalling yards: Köln, Koblenz, Oberlahnstein, Wiesbaden, Frankfurt.
Locomotive sheds: Köln, Troisdorf, Linz, Neuwied, Engers, Koblenz, Oberlahnstein, Niederlahnstein, Wiesbaden, Frankfurt.
Mileage datum: Köln Hbf.

The daily capacity of this trunk line is high, with 72 trains each way of 500 tons net load.

Crossing to the east bank of the Rhine by the great Hohenzollern bridge (Fig. 72, Plate 51), the line turns south through the complicated junction to Köln-Kalk (2·6 km.—1·6 miles), swings east to Troisdorf (21·0 km.—13 miles) and turns back to the river at Beuel (30·1 km.—18·6 miles), which lies opposite Bonn. From Beuel it follows the river to Ehrenbreitstein. A branch turns east here and with a 1,970-ft. tunnel through a spur in this suburb of Koblenz, and by means of the 1,250-ft. Horcheim bridge, reaches the town of Koblenz.

Keeping on the west bank at the base of the slopes of the Rhine gorge the railway reaches St Goarshausen (124·0 km.—77 miles) and then traverses a 650-ft. tunnel under the Lorelei and a 490-ft. tunnel under Ross-Stein. Turning east at Rüdesheim (152·9 km.—77·8 miles), the railway runs on a narrow terrace which widens towards the east, at the foot of the Rheingau Gebirge to Wiesbaden (186·0 km. —115 miles), where a spur off the main line leads to the principal station. Turning east but keeping on the north bank of the Main the railway enters Frankfurt.

The Ruhr

This industrial region extends eastwards from the Rhine as far as Hamm and Soest and from Recklinghausen in the north to Solingen in the south. It includes the valleys of the Ruhr and Lippe and the lower valley of the Wupper. The principal routes are extended east and west along the line of these valleys, but there are a number of

cross-routes extending north from the Wupper valley to the Ruhr and Lippe. On the west traffic is focused on the bridges across the Rhine at three crossings—Düsseldorf, and Duisburg-Hamborn, as well as on the Rhine ports of Walsum, Duisburg-Ruhrort and Düsseldorf. On the east the flow of traffic passes mainly through Hamm and Soest. South-eastwards the main lines run through Arnsberg and Altena, while southwards lines from the western end run through Mülheim to cross the Rhine by the great bridges at Köln. The early importance of these routes is shown by the opening dates of railway sections, e.g. Düsseldorf to Elberfeld, 1841; Duisburg to Düsseldorf, 1846. The Ruhr possesses the greatest concentration of railway tracks in the world. The Essen R.B.D., which covers the greater part but not the whole of the district, in an area about equal to that of the Duchy of Luxembourg, has 1,254 km. (779 miles) of route and 5,045 km. (3,358 miles) of track—a greater length of track than in the whole of Norway. The Ruhr region is the heart of Germany's heavy industries, despite many efforts in the direction of decentralization. The area lying within 50 miles of Duisburg-Hamborn in 1935 accounted for 10% of the population, 75% of the coal output and 80% of the iron and steel production of Germany.

Physical Background

The Ruhr industrial area extends from the northern edge of the Sauerland upland area into the lowland 'bay' of Münster or Westphalia. The older coal workings in the Ruhr valley, despite great fault disturbance, have given life to an otherwise resourceless region. The more productive coal seams in the lowland are now worked by deep shafts as far north as the Lippe valley. The reserves are enormous and the field is the largest European producer.

Between the Emscher and Lippe valleys the ground rarely rises above 360 ft., and this modest elevation, with the numerous side valleys, has facilitated railway building to the north of the Emscher. South of the Emscher valley the ground rises to about 900 ft., with a gentle north-facing slope. The Ruhr river is deeply cut into this terrain and the floodplain, up to a kilometre wide, is bounded by sharp bluffs on both sides. In the west the ground is lower, and here is found the great urban spread of Duisburg-Essen-Gelsenkirchen-Oberhausen. Railway construction is comparatively easy west of Witten, at least along the line of the valleys. South of the Ruhr valley the ground rises above 1,300 ft. The need of a connexion with the Wupper valley led to the development of the difficult routes

north of Wuppertal. The lay-out of these lines, with winding routes following the small upland rivers, is very different from that of the lines to the west between Düsseldorf and Duisburg, where the Rhine lowland permits a long stretch of dead straight track. East of Vohwinkel the Wupper turns south and settlement and railways avoid this deeply cut section of the valley. Upstream of Vohwinkel in the twin town of Wuppertal (Elberfeld-Barmen) the absence of flat ground led to the construction of the overhead railway which partly uses the river as a path (Plate 51). North-east of Wuppertal a narrow valley, followed by three lines of railway, two of which are double tracked, leads through the railway centre of Hagen to the upper Ruhr valley. South-east from Hagen a winding double track route leads up the steep-sided Volme valley, a route which was difficult to build, having several long tunnels, and which is difficult to operate owing to the sharp curves and steep gradients. It provides, nevertheless, a valuable link with the iron-mining area to the south.

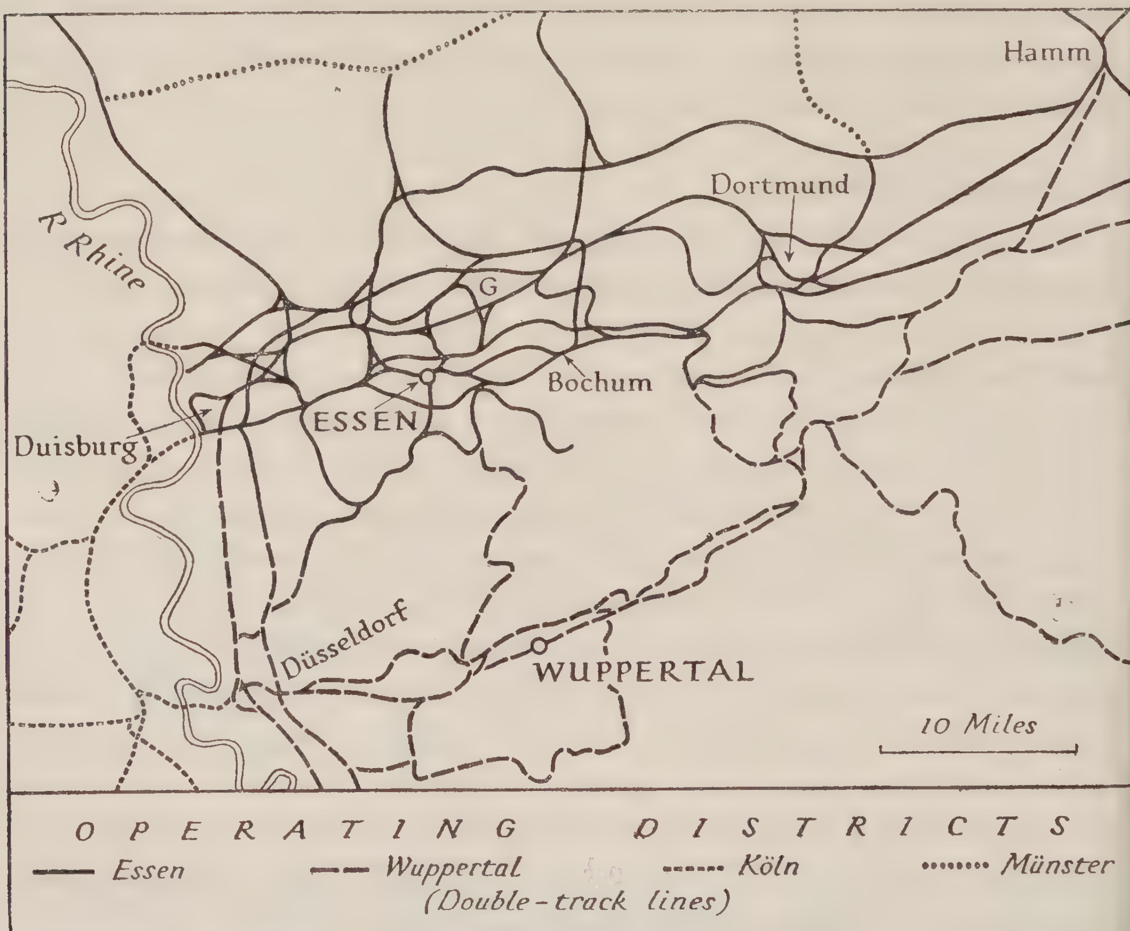


Fig. 77 *Reichsbahndirektionen* in the Ruhr
Based on official sources.
G Gelsenkirchen.

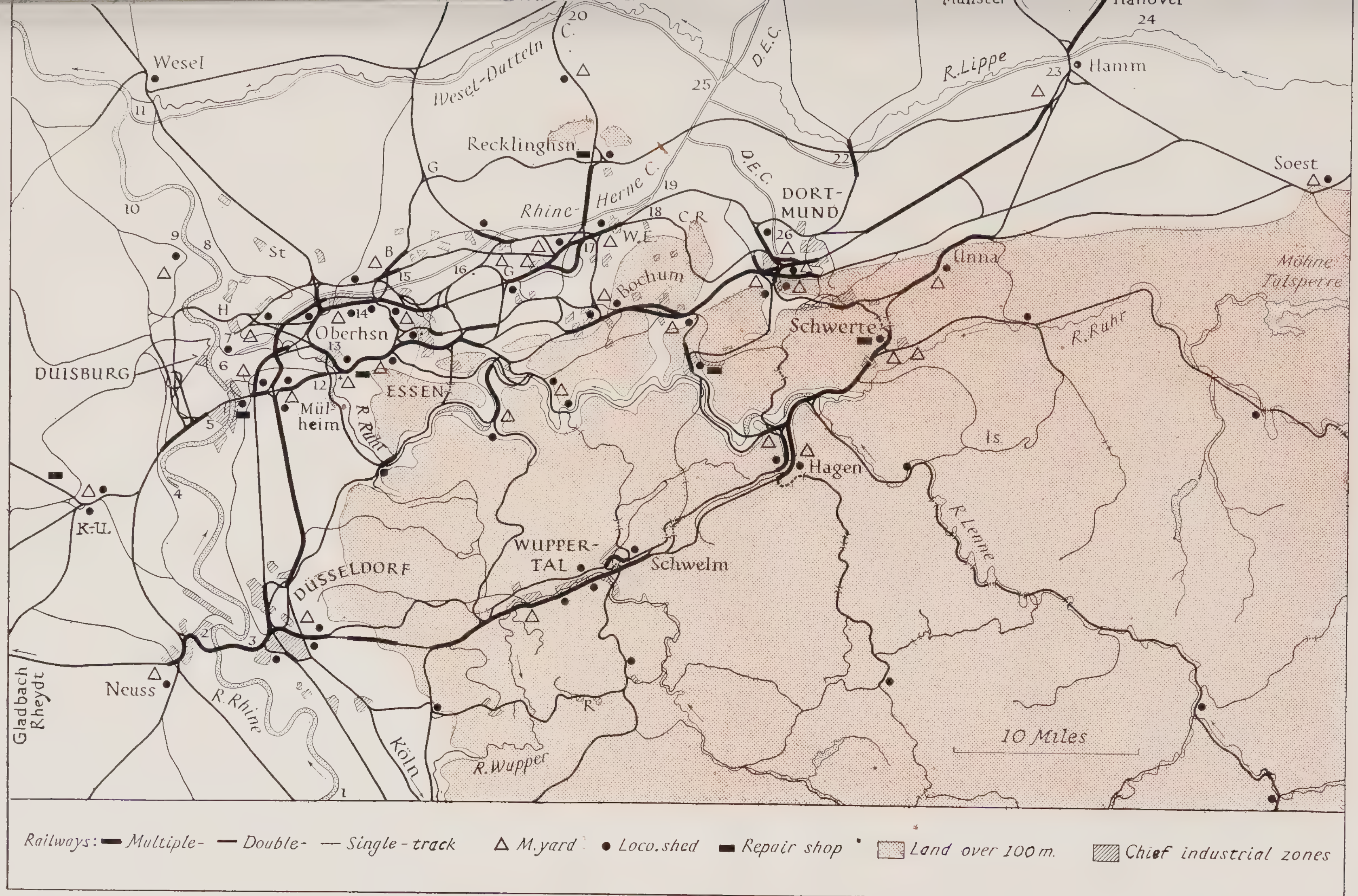


Fig. 78. The railways of the Ruhr, showing also waterway ports handling over 200,000 tons in 1937

Based on various official sources, including G.S.G.S. Series 4416, 1 : 100,000, Sheets Q1, Q2, Q3, Q4; *Die Binnenschiffahrt im Jahre* 1937, p. 5 (Berlin, 1938).

Is Iserlohn; R Remscheid. Ports: 1 Leverkusen-Monheim; 2 Neuss; 3 Düsseldorf; 4 Krefeld-Uerdingen; 5 Rheinhausen; 6 Duisburg; 7 Homberg; 8 Walsum; 9 Orsoy; 10 Rheinberg-Ossenberg; 11 Wesel; 12 Mülheim; 13 Oberhausen; 14 Essen; 15 Bottrop; 16 Gelsenkirchen; 17 Wanne-Eickel; 18 Herne; 19 Castrop-Rauxel; 20 Hamm-Rossendorf; 22 Lünen; 23 Hamm; 24 Ahlen; 25 Datteln; 26 Dortmund.

The various routes going south are bound together by the cross route from Marienheide through Wermelskirchen to Opladen.

Railway Divisions

This region comprises the greater part of the operating divisions (R.B.D.s) of Essen and Wuppertal; there is also a small mileage of privately-owned lines. The tracks of the R.B.D. of Essen include the tracks of the intricate network which occupy the lower Ruhr. Owing to the density of population stations in this district are as close together as anywhere in Germany outside Berlin. The railways of the R.B.D. of Wuppertal include two parallel routes from Düsseldorf to a point north of Hagen, with secondary routes running north and south. The most intricate knots of line are at Düsseldorf and Hagen.

Engineering Structures

Tunnels have had to be constructed at the head of the Ruhr and Wupper valleys to open a way eastwards and also through the ridge between these valleys and the high ground of the Wupper in order to reach the iron ore of the Sieg valley.

Location	Name of tunnel	Section	Length, ft.	No. of tracks
At head of valley	Schwelm	Wichlinghausen—Obervogelsang	2,428	2
Between Ruhr and Wupper Valleys	Asbeck	Wuppertal-Barmen—Witten	3,300*	1
	Ostberger	Schwerte—Holzwickede	2,625*	2
	Aplerbeck Süd	Horde—Schwerte	2,611	2
	Schee	Wuppertal-Barmen—Hattingen	2,342	2
	Gevelsberg West	Wuppertal-Barmen—Witten	2,296*	1
South of Wupper valley	Geldberg	Hagen—Oberhagen	7,218	2
	Heinsberg	Altenhundem—Birkelbach	4,273	1
	Buchholzer	Hagen—Siegen	3,071	2
	Husberg	Hagen—Siegen	2,598	2

* Approximate.

From official sources.

The rivers Rhine, Ruhr and Wupper have all demanded the construction of large bridges. Those over the Rhine are much the largest, but those over the other rivers are considerable structures.

Principal Bridges

No. on Map	Bridge	Over	Date built	Length, ft.	No. of tracks	Notes
6	Duisburg-Ruhrort	R. Rhine	1910–2	3,000	2	Steel spans
7	Duisburg-Hochfeld	R. Rhine	1925–7	3,061	2	,, ,,
8	Mülheim-Ruhr	R. Ruhr	1926	401	2	,, ,,
9	Kettwig	R. Ruhr	1926	624	2	,, ,,
10	Herdecke	R. Ruhr	?	984	2	Stone or brick arches*
11	Elberfeld-Sonnborn	R. Wupper	1913	321	2	Stone three-hinged arch
13	Müngsten	R. Wupper	1894–7	1,591	2	Steel spans
	Düsseldorf-Hamm	R. Rhine	1851, 1912	2,706	2	Steel arches
	Düsseldorf-Hamm	R. Rhine	1911	2,706	2	,, ,,

* Partly destroyed in the air attack on the Möhne Dam.

From official sources.

The location of these bridges is shown in Fig. 51.

Railway Operating Features

In this region, on account of the huge tonnage of coal moved, are found both the greatest number of marshalling yards and the largest yard in Germany—at Hamm. This yard has a daily capacity of 10,000 wagons. The yard may be regarded as a gateway to the Ruhr district both from Bremen—Hamburg and from Hanover—Berlin; there are two 'gateway' yards nearby in a similar position, at Unna and Soest. In the R.B.D.s of Essen, Wuppertal and Köln, which serve the Ruhr directly or indirectly, there are 41 major marshalling yards which can handle a total of nearly 150,000 wagons daily. Smaller yards are situated at Wanne-Eickel and Barmen.

Automatic train control is used on several important routes in and around this region, e.g. Oberhausen—Hamm—Gütersloh—Essen—Recklinghausen — Münster, Düsseldorf — Wuppertal — Hagen — Hamm, Köln—Duisburg—Oberhausen. The control system employs magnets on the track which engage with magnets on the locomotives, and unless the driver acknowledges an adverse signal by pressing a button, the train is stopped. A system of traffic control is used on certain lines in the Ruhr area. With the large proportion of double-track and the shortness of the block sections, the capacity of the lines is high and the double tracks might be able to carry 144 trains each way daily, but the capacity is, owing to limited terminal facilities,

more likely to be 72 trains a day (i.e. 1 every 20 minutes). The heavy traffic of the Ruhr is shown by the number of locomotives stationed there in 1936, viz., 1,210 in R.B.D. Essen and 897 in R.B.D. Wuppertal. These locomotives are kept at 34 sheds in the Essen district and at 26 in the Wuppertal district. The sheds are normally of the roundhouse type, and as a rule do not accommodate more than 40 locomotives; when more are required, as at Duisburg, 4 separate depots are provided. There are a considerable number of repair workshops in the region, mainly near its margin, to meet the needs of the large movement of rolling stock.

Shop	Repairs to:	No. of employees, 1937
Mülheim-Speldorf	Locomotives	1,582
Recklinghausen	Rolling stock	1,455
Witten	Permanent way	972
Duisburg*	Goods wagons	1,428
Opladen	Rolling stock	1,934
Schwerte	Locomotives	2,173

* Formerly known as Wedau.

From official sources.

At Witten, between Bochum and Hagen, there is a main Reichsbahn permanent way depot and workshop, employing about 1,000 workers. The numerous steel works of the district, e.g. *Krupps* and the *Bochumer Verein*, produce rails, points, etc., for the Reichsbahn.

Traffic

Passenger Traffic. There is a dual set of passenger movements in this region: the long distance D trains between the North German Plain and the Rhineland, and the local services. Hence there are a number of very intensive passenger services. All passenger trains are steam operated. Both Wuppertal and Essen have about 105 ordinary passenger trains daily in their suburbs. The line east from Wuppertal in 1938 carried about 50, but that west to Düsseldorf only about 35. By contrast, the lines west from Essen carried 92 trains, whereas that to the east only 19. The northern latitudinal line from Dortmund to Gelsenkirchen had 79 trains and the westward extension 64. Of the north-south lines the most important were Duisburg—Düsseldorf (79), Oberhausen—Wesel (32) and Gelsenkirchen—Recklinghausen (46). None of the other lines carried more than 20 passenger trains. In 1937, R.B.D. Essen ranked as the seventh division and R.B.D. Wuppertal as ninth for the number of passenger tickets sold.

Goods Traffic. The tonnage of goods forwarded in the R.B.D.s of Essen and Wuppertal was about 108 million in 1936, and the number

of ton-kilometres worked was 7,300 million, i.e. about one-fifth and one-tenth respectively of the totals for the whole Reichsbahn system. As the track only represents about one-fiftheenth of that of the total route length, the intensive use of the lines in this area is evident. The average *net* goods train load was, in 1936, 380 tons for R.B.D. Essen and 339 tons for R.B.D. Wuppertal, compared with an average of 307 tons for the whole Reichsbahn. The average *gross* weight of the goods trains in Germany was 701 tons. Essen, in particular, greatly exceeds the average, therefore. It is probable that if the light local trains were omitted from the calculation the main-line trains

Fig. 79. The most important lines in the Ruhr, according to R. Niemeyer
Based on a map entitled 'Die wichtigsten Eisenbahnlinien des Ruhrgebiets', in Niemeyer, R., 'Städtebau und Nahverkehr', *Verkehrstechnik*, Heft 18, pp. 434–9, Heft 19, pp. 453–5 (Berlin, 1939).

carrying coal and iron ore would reach a weight of 1,200 tons net (1,800–2,000 tons gross).

The flow of mineral and goods traffic within the Ruhr focuses upon Hamm in the east and the Duisburg area in the west. The routes of heaviest traffic are between (i) Duisburg and Ratingen; (ii) Bochum and Langendreer; (iii) Duisburg-Ruhrort, Gelsenkirchen and Mengede; and (iv) between Dortmund and Hamm. Between the Ruhr and the rest of Germany the heaviest traffic to the south is carried by the Rhine valley routes and to the north and north-east by the routes from Münster to Hamburg, Hamm to Lehrte, and Soest to Halle. Outward traffic is heavier than inward owing to the importance of the coal trade.

The traffic districts taken as covering the Ruhr are Westphalian

Ruhr, Rhine Province Ruhr and Duisburg, Duisburg-Hochfeld, Ruhrort. Köln, which is not within the region here described, handles much of the trade and is dealt with on p. 315.

Traffic, 1936 (*in thousands of tons*)

District	Local	Loaded to	Unloaded from	Loaded to	Unloaded from
		other German districts		foreign countries	
Westphalian Ruhr	14,440	44,875	13,324	4,346	686
Rhine Province Ruhr	7,278	20,348	14,113	1,875	153
Duisburg, D.-Hochfeld Ruhrort	527	4,582	16,394	82	49

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1936*, Heft I, II, *passim*.

The table shows the great lack of balance of both German and foreign loadings over unloadings except for the port of Duisburg, to which coal is sent from the Ruhr for shipment on the Rhine. The high value of local loadings is also significant, for there is a heavy movement of coal from the local pits to the steel works and of pig iron and steel ingots from the steel works to the various workshops. Coal and iron and steel ingots, bars, etc., are also exchanged between the districts making up the Ruhr area and with the neighbouring districts. The Westphalian Ruhr traffic district handles the heaviest tonnage of goods moving to the districts, nearly 10 million tons passing outwards to Duisburg alone; from the other areas the heaviest tonnage goes to the Weser ports. The leading export is coal, followed by iron and steel products. A considerable tonnage of fertilizers, particularly basic slag, goes to the areas of poor soil in the North German Plain and in south Germany. Imports by rail include fish and fruit from the Elbe ports, potatoes from the North German Plain, pitprops from north-eastern and central Germany, iron and manganese ores from wherever they can be obtained, including the North Sea ports (mostly Emden), and potash fertilizer from the Merseburg area. Exports abroad, direct by rail, are mainly coal and coke, and the principal imports are iron and manganese ores from France, Luxembourg and Hungary. The Rhine Province Ruhr traffic district mainly repeats the Westphalian Ruhr type. Additional items include milk from Westphalia and sulphuric acid from Köln. The Duisburg traffic district handles much less than the two previous regions. The chief items of import are nitrogenous fertilizers, cement and iron ores. Exports from this district include basic slag,

benzin and diesel oil, as well as steel products and scrap iron to Czechoslovakia.

The traffic of the Ruhr region may be illustrated by a summary of the larger items in the movement to and from the railway traffic district (Westphalian Ruhr, No. 22), which provides the greatest tonnages. (See table on opposite page.)

Route Descriptions

(17) Dortmunderfeld—Hamm
(18) Oberhausen-Gelsenkirchen—Dortmund
(19) Oberhausen—Essen—Bochum—Schwerte
(20) Düsseldorf—Wuppertal—Schwerte—Hamm
(21) Oberhausen—Duisburg—Düsseldorf
(22) Recklinghausen—Gelsenkirchen

(17) *Dortmunderfeld—Hamm*

Length: 36·9 km. (22·9 miles).
Track: Dortmunderfeld to Dortmund Hbf., multiple; Dortmund to Scharnhorst, double; Scharnhorst to Hamm, multiple.
Maximum permissible axle-load: 20 tons.
Traction: Steam.
Maximum distance between stations: Kamen to Nordbögge Halt, 10 km. (6·2 miles).
Marshalling yards: Dortmunderfeld, Hamm.
Locomotive sheds: Dortmunderfeld, Dortmund Hbf., Hamm.
Mileage datum: Dortmunderfeld.

The daily capacity of this short but important line is high at 96 trains each way. Running from the northern outskirts of the old centre of Dortmund, this route gathers important lines from Hörde, Witten, Bochum and Wanne, and throws off branches to factories and mines. Beyond Dortmund the railway runs dead straight to Nordbögge (28·2 km.—17·5 miles) through the headstream valleys of the Körne and Seeseke rivers. At Nordbögge it changes direction slightly and enters Hamm from the south.

(18) *Oberhausen—Gelsenkirchen—Dortmund*

Length: (*a*) Oberhausen to Gelsenkirchen, 18·4 km. (11·4 miles).
(*b*) Gelsenkirchen to Dortmund, 30·6 km. (19·0 miles).
Track: (*a*) Oberhausen to Essen-Altenessen, multiple.
(*b*) Altenessen to Gelsenkirchen, double.
(*c*) Gelsenkirchen to north of Herne, multiple.
(*d*) North of Herne to Dortmund Hbf., double.
Maximum permissible axle-load: 20 tons.
Traction: Steam.
Maximum distance between stations:
(*a*) Oberhausen Hbf. to Essen Frintrop, 4·5 km. (2·8 miles).
(*b*) Herne to Rauxel, 7·9 km. (4·9 miles).
Marshalling yards: Oberhausen, Essen-Frintrop.
Locomotive sheds: Oberhausen, Essen-Frintrop, Gelsenkirchen.
Mileage datum: Oberhausen.

Goods Traffic of the Westphalian Ruhr district, 1936, (*by traffic districts to or from which commodity items of* 50,000 *tons or more were despatched or received, in thousands of tons*

	Outwards from No. 22	Inwards to No. 22
Mecklenburg	Coal (104·9)	—
Baltic ports from Rostock to Flensburg	Coal (327·3), coke (174·4)	—
Scheswig-Holstein	Coal (313·9), coke (193·4)	—
Elbe ports	Coal (184·6), coke (355·3), miscellaneous iron and steel (52·9)	Iron and manganese ores (97·6)
Weser ports	Coal (1,785·0), coke (822·3), bar iron and steel (13·2), sheet steel and tin plate (76·5), iron and steel wire (66·2), miscellaneous iron and steel (52·5)	—
Ems ports	Coal (668·4) coke (249·0)	Iron and manganese ores (452·0)
Oldenburg	Coal (876·4), coal briquettes (83·1), coke (278·8), sand (66·9), basic slag (97·4)	Potatoes (104·9), pitprops (142·2)
Hanover and Hildesheim	Coal (1,002·9), coal briquettes (167·2), coke (260·6), steel ingots (58·3)	Iron and manganese ores (164·4)
Berlin	Coal (532·7), coal briquettes (56·7), coke (288·0), bar iron and steel (70·6)	—
Brandenburg	Coal (252·9), coal briquettes (61·0), coke (105·9), basic slag (79·8)	Pitprops (116·7)
Magdeburg Anhalt	Coal (393·8), coal briquettes (97·7), coke (143·1)	Pitprops (53·8)
Merseburg and Erfurt	Coal (561·5), coal briquettes (92·1), coke (1,347·2)	—
Thuringia	Coal (464·4), coal briquettes (85·4), coke (329·3)	—
Saxony	Coal (61·1), coal briquettes (148·5)	—
Leipzig	Coal (69·4), coke (60·8)	—
Hesse-Nassau	Coal (873·6), coal briquettes (123·9), coke (370·9)	Iron and manganese ores (169·6), worked stone (311·0), other mineral raw materials (63·4), pitprops (158·9)
Frankfurt-am-Main	Coal (194·5)	—
Rhine Prov. Ruhr	Coal (1,900·6), coal briquettes (96·6), coke (731·1), coal oil derivatives (69·6), worked stone (77·2), sand (286·9), limestone (55·8), unspecified chemicals (56·2), crude iron and iron alloys (64·5), steel ingots (213·5), scrap iron (87·9), bar iron and steel (121·9), sheet steel and tinplate (81·9), iron and steel tubes (55·9)	Coal (681·0), coke (283·7), worked stone (415·2), sand (886·5) limestone (83·6), crude iron and iron alloys (100·9), steel ignots (119·4), bar iron and steel (261·9), sheet steel and tinplate (138·7), iron and steel tubes (54·7), iron and steel wire (60·1), other foundry goods (82·5)
Westphalia	Coal (2,516·6), coal briquettes (146·4), coke (648·7), sand (437·3), steel ingots (360·4), basic slag (130·9), bar iron and steel (149·5), sheet steel and tinplate (86·0)	Iron and manganese ores (432·7), coal (198·1), worked stone (113·6), sand (336·3), limestone (93·0), cement (257·6), pitprops (224·4), scrap iron (117·6)
Rhine prov. E. of Rhine	Coal (232·9), coke (141·8), sand (100·9), steel ingots (230·8)	Iron and manganese ores (68·4), worked stone (113·9), sand (130·4), artificial stone (53·1)
Rhine prov. W. of Rhine	Coal (693·1), coke (961·5), bar iron and steel (66·5)	Lignite (286·0), sand (451·9), artificial stone (81·8)
Köln	Coal (66·5)	—
Duisburg	Coal (7,696·1), coal briquettes (95·1), coke (1,263·8), sand (73·9)	Iron and manganese ores (255·2), sand (323·7), steel ingots (57·1), scrap iron (172·4), bar iron and steel (52·5)
Hesse	Coal (97·1)	—
Baden	Coal (155·7)	—
Mannheim and Ludwigshafen	Coal (61·4)	—
Württemberg	Coal (185·1)	Iron and manganese ores (52·0)
S. Bavaria	Coal (200·9), coal briquettes (54·9), coke (133·3)	—
Munich	Coal (76·8), coke (106·4)	—
N. Bavaria	Coal (509·8), coke (279·0)	Iron and manganese ores (85·9)
Alsace-Lorraine	Coke (428·8)	Iron and manganese ores (463·3)
Hungary	Coal (106·2), coke (112·2)	—
Austria	Coal (87·4), coke (103·8)	—
Switzerland	Coal (75·7), coke (181·2)	—
France and Iberia	Coke (288·4)	Iron and manganese ores (75·2)
Luxembourg	Coke (1,514·8)	Iron and manganese ores (55·7)
Belgium	Coal (109·5)	—
Netherlands	Coal (454·4), coke (110·1)	—

Running north of east out of Oberhausen and lying on the south of the Rhein-Herne C. the railway goes straight through the edge of the northern built-up area of Essen to Gelsenkirchen (18·4 km.—11·4 miles). Passing through Wanne-Eickel marshalling yard (23·7 km.—14·7 miles), the line turns north-east to Rauxel (35·5 km.—22·0 miles), then south to Dortmund (49·0 km.—30·4 miles). By swinging north to Rauxel the railway follows the valley used by the Emscher C. (which is at a lower altitude here than the Dortmund-Ems C.) and so meets easier gradients than if it followed a direct route.

(19) *Oberhausen—Essen—Bochum—Schwerte*

Length: about 57 km. (35·4 miles).
Track: (*a*) Oberhausen to Mülheim-Styrum, double.
(*b*) Mülheim-Styrum to Essen Hbf., multiple.
(*c*) Essen Hbf. to Bochum Süd, double.
(*d*) Dortmunderfeld to Schwerte, double.
Maximum permissible axle-load:
(*a*) Oberhausen to Hörde, 20 tons.
(*b*) Hörde to Schwerte, 18 tons.
Traction: Steam.
Maximum distance between stations: Lütgendortmund to Hörde, 9·7 km. (6·0 miles).
Marshalling yards: Oberhausen, Mülheim-Ruhr-Speldorf, Bochum Süd, Langendreer.
Locomotive sheds: Oberhausen, Mülheim-Styrum, Essen Hbf., Langendreer.
Mileage datum: Oberhausen.

From Oberhausen the railway runs south-east past the marshalling yard and *Thyssen* steel works, and after approaching close to the Ruhr river turns north-east at Mülheim (5·0 km.—3·1 miles) to Essen. It enters this town at Essen West (14·7 km.—9·1 miles), and skirting the southern edge of the *Krupp* works, into which it sends branches, runs through the northern suburbs, to Kray and Wattenscheid (24·9 km.—15·5 miles). From here the line curves south and then north-east with the town of Bochum (29·9 km.—18·5 miles) lying to the north-east of the line for a considerable distance. From Bochum Süd the railway passes east through Langendreer to Lütgendortmund. The line turns near Marten and after crossing the Neue Emscher C. (48·8 km.—30·3 miles) avoids entering Dortmund by turning south and then east through Hörde (50·6 km.—31·4 miles). Striking south-east and passing by a tunnel about 2,600 ft. long under a ridge 650 ft. high, the line, by a reverse junction, reaches Schwerte (see p. 335).

(20) *Düsseldorf—Wuppertal—Schwerte—Hamm*

Length: 102·4 km. (63·6 miles).
Track: (*a*) Düsseldorf Hbf. to Düsseldorf-Gerresheim, multiple.
(*b*) Düsseldorf-Gerresheim to Erkrath, double.
(*c*) Erkrath to Hochdahl, multiple.
(*d*) Hochdahl to Gruiten, double.
(*e*) Gruiten to Schwelm, multiple.
(*f*) Schwelm to Hagen, double.
(*g*) Hagen to north of Schwerte, multiple.
(*h*) Schwerte to Holzwickede, double.
(*i*) Holzwickede to Unna, multiple.
(*j*) Unna to Hamm, double.

Maximum permissible axle-load: 20 tons.
Traction: Steam.
Maximum distance between stations: Schwerte to Holzwickede, 9·1 km. (5·6 miles).
Marshalling yards: Düsseldorf, Vohwinkel, Langerfeld, Hengstey (Hagen), Hamm.
Locomotive Sheds: Düsseldorf Hbf., Wuppertal-Vohwinkel, Elberfeld-Steinbeck, Wuppertal-Langenfeld, Hagen-Eckesy, Schwerte, Holzwickede, Hamm.
Mileage datum: Düsseldorf Hbf.

Leaving the main station, the line runs east alongside the chief factory area of Düsseldorf and leaves the Rhine floodplain at Düsseldorf-Gerresheim (5·4 km.—3·3 miles). Continuing due east, it ascends above the Düssel Bach valley to Vohwinkel (20·7 km.—12·8 miles), which lies in a dry valley above the deeply-cut trench of the Wupper river. Keeping at first on the northern flank and slowly dropping in height, it crosses the Wupper east of Sonnborn (23·3 km.—14·4 miles) and runs on the south side of the river through the extensive built-up area of Wuppertal. In this section, where factories and housing blocks alternate, stations are only about 2 km. apart. Leaving this industrial area and the valley of the Wupper near Langerfeld (35·5 km.—22·0 miles), the railway runs to the north of Schwelm (37·7 km.—23·4 miles) on the gentle southern flank of a minor valley. Beyond Schwelm the valley sides steepen and the railway passes by a narrow col into the Ennepe valley. Making its way between a steep hillside and the industrial works lining the river, the railway swings north at Hagen (55·4 km.—33·1 miles); many tracks are cramped in the lower valley of the Volme just before it debouches into the Ruhr valley. Running beside a reservoir which occupies part of this valley, the railway crosses the confluence of the Lenne and Ruhr rivers at the head of the reservoir (59·5 km.—36·9 miles) and, rising past Schwerte (68·1 km.—42·8 miles), tunnels for about 2,620 ft. under the 620-ft. high ridge separating the Ruhr and Emscher valleys. Crossing the small upper Emscher and Massener headwaters, the rail skirts Unna (84·0 km.—52·2 miles) and crossing

the head of the Körne river marshes runs due north-east to Hamm (102·4 km.—63·5 miles), which is situated on the southern bank of the Lippe river.

(21) *Oberhausen—Duisburg—Düsseldorf*

Length: 28·5 km. (17·7 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Traction: Steam.
Maximum distance between stations: Duisburg Hbf. to Oberhausen Hbf., 7·7 km. (4·8 miles).
Marshalling yards: Oberhausen, Duisburg Hbf., Düsseldorf-Derendorf.
Locomotive sheds: Oberhausen, Duisburg Hbf., Düsseldorf-Derendorf.
Mileage datum: Oberhausen.

From Oberhausen station, which lies on the southern edge of the intricate network of tracks parallel with the Rhein-Herne C., the route strikes south-west to Duisburg, throwing off a branch to Duisburg-Ruhrort. At both ends of the station, branch lines connect with the port of Duisburg, while in addition from the southern end a line joining the main line from Essen to Mülheim crosses the Rhine by Duisburg-Hochfeld bridge. South of Duisburg the railway runs for 17·6 km. (10·9 miles) dead straight between a forest belt to the east and the Rhine to the west. There is a parallel line about 2 to 3 km. to the east running through the forest, at an altitude of about 115 ft. Entering the very important industrial centre of Düsseldorf through the northern industrial suburbs, this line is joined by double-track lines from Vohwinkel, from Mülheim-Köln and from Neuss and Gladbach-Rheydt on the west of the Rhine.

(22) *Recklinghausen—Gelsenkirchen*

Length: 15·6 km. (9·7 miles).
Track: Recklinghausen to south of station, double.
South of Recklinghausen Hbf. to Gelsenkirchen, multiple.
Maximum permissible axle-load: 20 tons.
Traction: Steam.
Maximum distance between stations: Recklinghausen Hbf. to Recklinghausen Süd, 6·1 km. (3·8 miles).
Marshalling yards: Wanne-Eickel, Gelsenkirchen Hbf.
Locomotive sheds: Recklinghausen, Wanne-Eickel, Gelsenkirchen.
Mileage datum: Recklinghausen Hbf.

This line is part of a busy cross-route between Münster and Köln. Consisting for the greater part of multiple track, it can cope with 96 trains per day each way. From Recklinghausen station, which lies on the east of the town, the line follows a straight course just west of

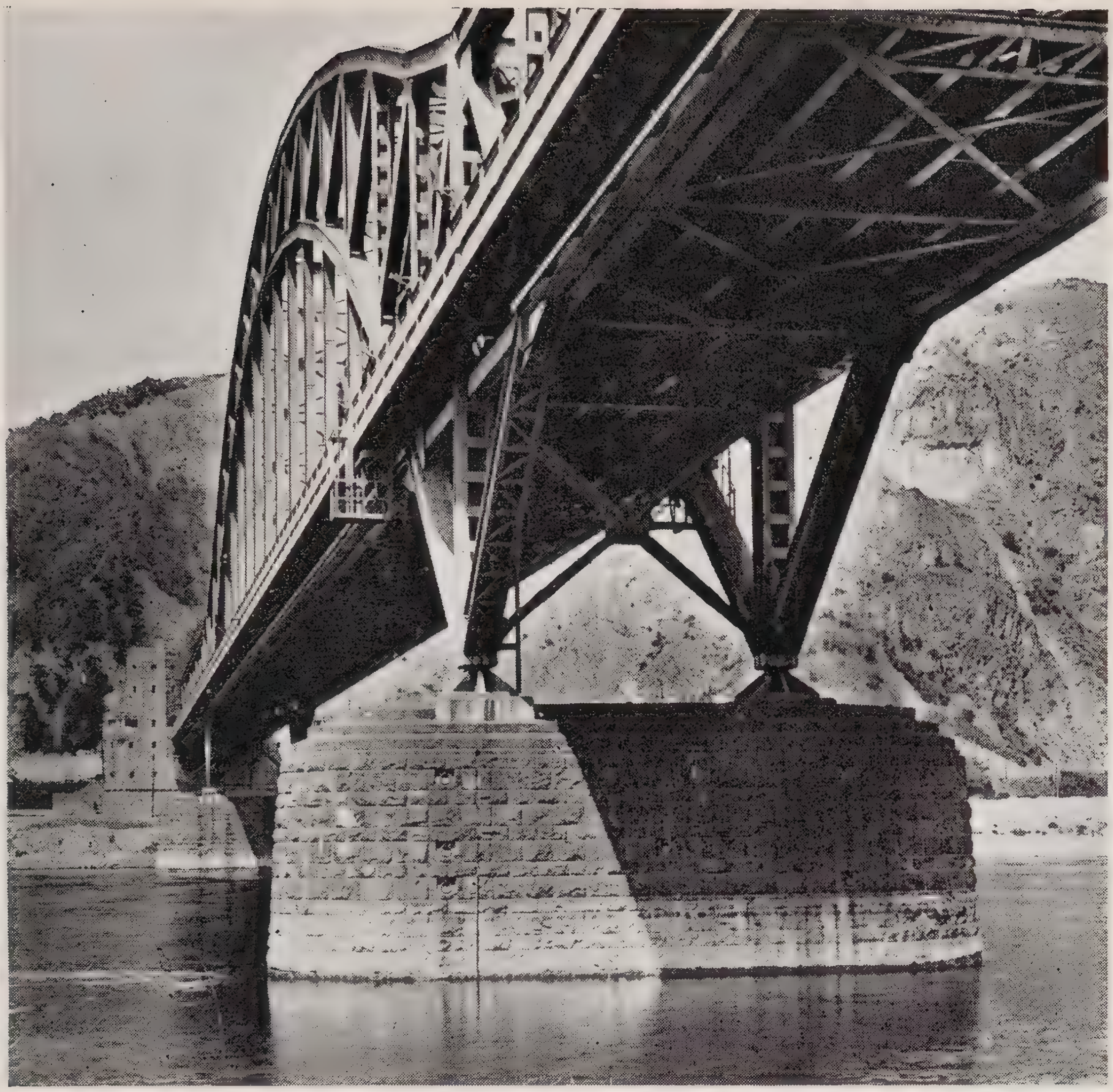


Plate 49. The Remagen (*Ludendorff*) railway bridge over the Rhine

Details of this bridge will be found on p. 314. It was constructed for military purposes during the war of 1914–1918.

Plate 50. Köln (Cologne): bridges and fly-overs

This view was taken from Bridge 392 and shows Bridges 393–8 and the Kanalstrasse signal box. The junctions shown provide connexions between the Ehrenfeld and Nippes track groups on the one hand and the Gereon and Hauptbahnhof groups on the other (Fig. 72).

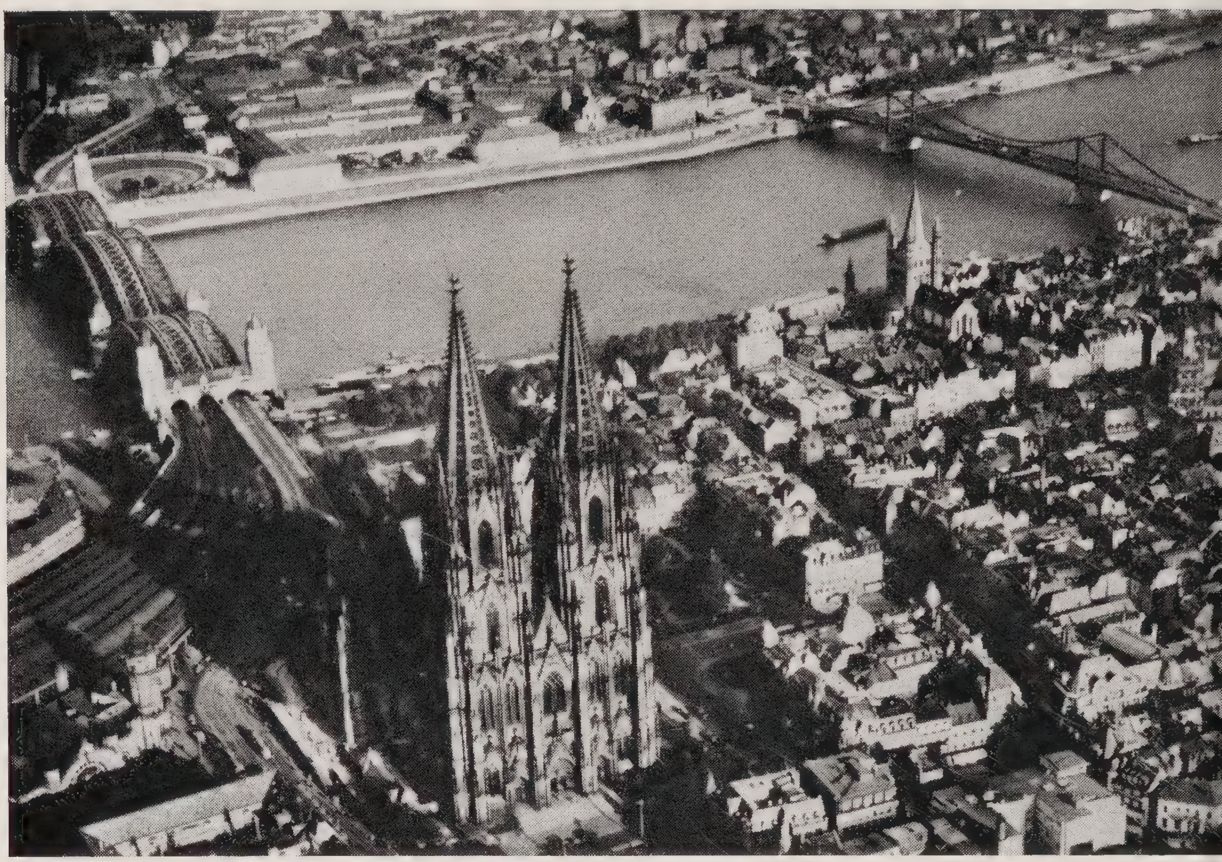


Plate 51. Köln (Cologne): Hohenzollern Bridge and Cathedral

This view is taken looking south-east. In the left foreground is the Hauptbahnhof. The bridge carried 4 rail tracks and a wide roadway. It is the second railway bridge on this site, for it was preceded by the Cathedral Bridge. To the right is the Deutz suspension road bridge, and on the east bank lies the suburb of Deutz.

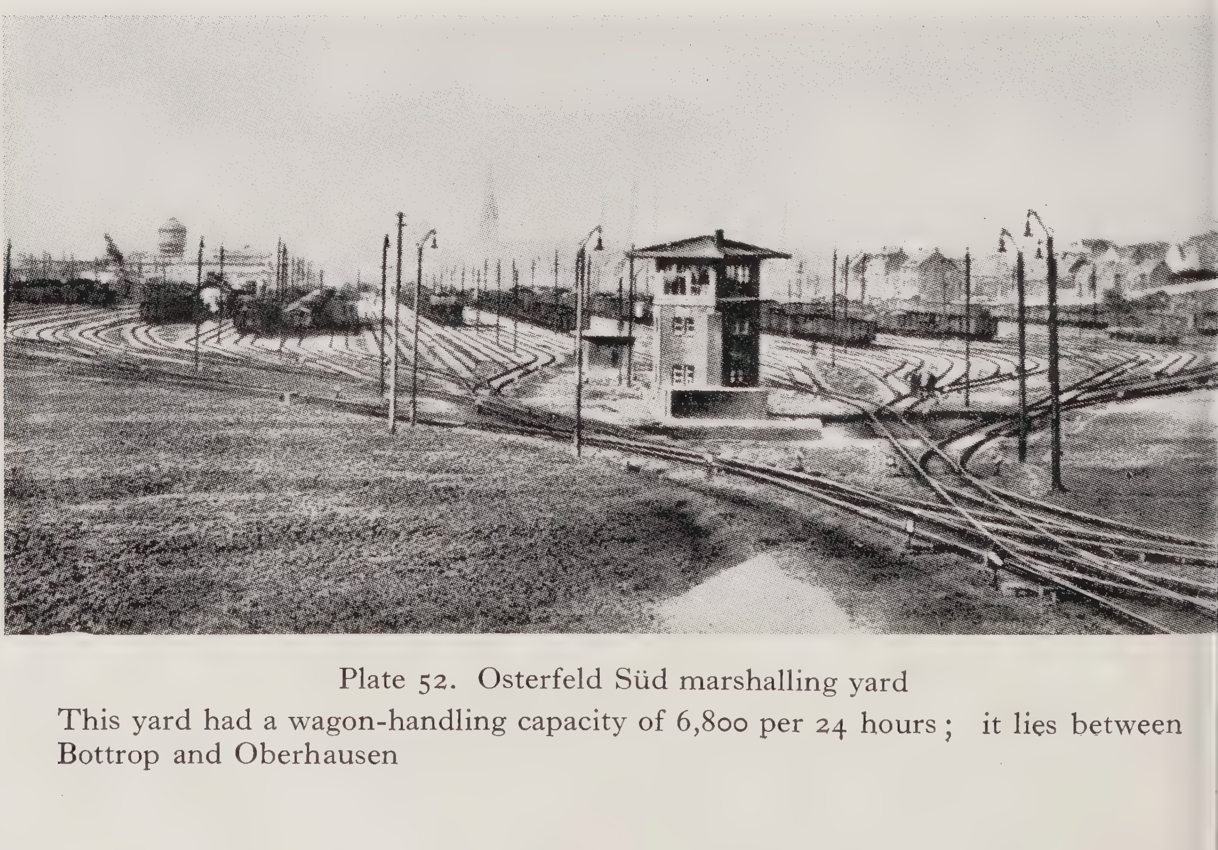


Plate 52. Osterfeld Süd marshalling yard

This yard had a wagon-handling capacity of 6,800 per 24 hours; it lies between Bottrop and Oberhausen

south. Spurs from the station link with the east-west line between Hamm and Gladbach and also provide connexion with the large rolling-stock repair shops and with nearby collieries. Crossing the Neue Emscher and the Rhine-Herne canals, the line swings to the south-west to Wanne-Eickel with its large marshalling yard. At both ends of the long axis of this yard are intricate fly-over and junction lines which provide connexion with the east-west lines of the northern industrial area. Some 5 km. (3·1 miles) beyond Wanne-Eickel is Gelsenkirchen station and marshalling yard. This last station has an alternative double-track route about a quarter of a mile to the east of the direct route.

The Upper Rhineland

This region is taken to extend eastwards from the Franco-German frontier beyond the watershed of the Black Forest nearly to Stuttgart, and southwards from the Main valley to the Swiss frontier. Apart from the network round Frankfurt-am-Main and Saarbrücken, the essential link is the longitudinal railway on the east bank of the Rhine which is paralleled by one on the west bank, crossing the frontier from the Palatinate into Alsace. The nodal point of these lines in the south is Basel, the principal connecting-point for Switzerland and the south. Kehl and Strasbourg serve as a junction for lines into France. Important latitudinal railways connect the Saar with the Rhineland and the Rhineland with Bavaria.

The long frontier with France divides into two sections: a northern section from Luxembourg to Karlsruhe and a southern section from Karlsruhe to Basel. The former, a land frontier, has six trans-frontier routes converging on the Saar and two routes from Winden and Wörth in the Rhine valley. The southern section has important crossings of the Rhine at Rastatt, Kehl, Breisach and Neuenberg, with a number of minor bridges between (Fig. 118). The Swiss frontier is crossed by rail at Basel (for Berne), Waldshut (for Koblenz in Switzerland), Waldshut (for Singen in Germany, cutting across the enclave of Swiss territory round Schaffhausen), Singen (for Etzwilen) and Konstanz.

Physical Background

The area is dominated by the Upper Rhine Plain, in which three physical zones may be distinguished: the floodplain, the upper terraces, and the foothill zone, with, in addition, the isolated mass of the Kaiserstuhl. The floodplain extends for a breadth of about 1½

miles at Basel, of $2\frac{3}{4}$ miles at Strasbourg, and has a maximum width of 6 miles. Sparsely populated, this plain is avoided by railways except at such places as Mannheim, Kehl and Breisach, where firm ground close to the river provides convenient bridging points. Backing the floodplain are broad, dry fertile terraces which, supporting a dense rural population, carry the main lines to the south on the east and west of the Rhine. These terraces rise into the foothill zone of low flat-topped limestone hills. The foothills are broken by depressions such as that of which Freiburg is the centre. These depressions provide an easy grade for side lines entering the Black Forest. The isolated volcanic mass of Kaiserstuhl is flanked on both sides by railways which use the firm ground it provides to reach the Breisach bridging point of the Rhine.

To the south-east lies the broken plateau of the Black Forest which has a steep descent to the Rhine valley and a long gentle slope to the east. Faults have aided the formation of deep river valleys such as the Kinzig, and through these valleys three routes, from Rastatt, Offenburg and Freiburg, respectively, lead across the Black Forest into south Germany. The route from Freiburg uses the upper Danube valley to cross the adjoining limestone plateau of the Swabian Jura. The northern fretted edge of the Swabian Jura is high and steep, up to 1,000 ft. above the Neckar Scarplands; it is crossed by several lines built with great difficulty across the water parting between the Rhine and Danube basins. The Neckar Scarplands lie at a height of about 1,000 ft. with the Neckar flowing through the western limestone part of the basin past the important engineering centre and railway junction of Stuttgart. The river crosses the southern Odenwald sandstone country by a series of very deeply incised meanders. Railway passage to Heidelberg is assured through this gorge by the old river terraces. The low plateau of Odenwald rises sharply above the Rhine plain, but the northern and southern margins slope gently into the surrounding districts. This area, with few local resources, has several cross-routes, as it lies between south Germany and the important Lower Main Plain.

On the west of the Rhine, between the Lauter valley and the Rhine Gorge, rise the higher areas of the Haardt, Rhenish Hesse (see p. 310), the Palatinate Scarplands, the Northern Palatinate Hills and the Saar coalfield. The Haardt mountains descend steeply to the Rhine Plain without a foothill zone. These mountains form a high plateau, about 2,000 ft. high, and the eastern edge, with steep and narrow valleys, is difficult for both railway construction and operation and so forms a

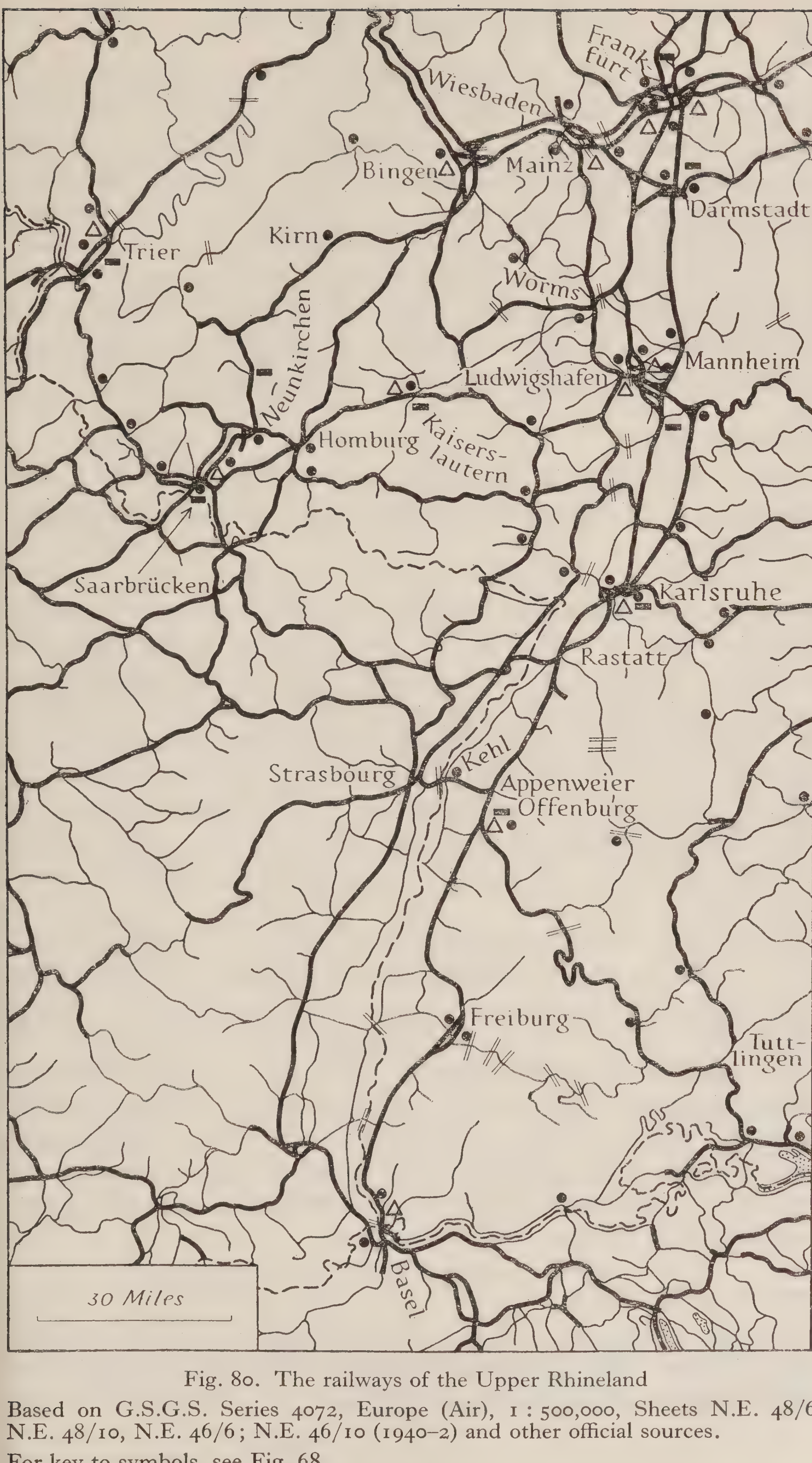


Fig. 80. The railways of the Upper Rhineland

Based on G.S.G.S. Series 4072, Europe (Air), 1 : 500,000, Sheets N.E. 48/6, N.E. 48/10, N.E. 46/6; N.E. 46/10 (1940–2) and other official sources.

For key to symbols, see Fig. 68.

marked contrast with the gentle valleys sloping towards the Saar coalfield. The Palatinate uplands are rural in character with open valleys. Kaiserslautern, an important railway junction, lies at the eastern end of a depression extending between the Middle Rhine and the Paris Basins. The Saar region consists of the coalfield area and the adjacent hills; settlement and communications are often closely confined within the valleys. Along the western edge of the Hunsrück upland the Saar has cut a deep valley which joins the Mosel valley near Trier and so provides a railway route between the coalfield and Koblenz, avoiding the high plateau of the Hunsrück.

Railway Divisions

Within this region lie the greater part of the R.B.D. of Karlsruhe, together with portions of the R.B.D.s of Saarbrücken, Mainz and Stuttgart.

The railways of the southern section of the R.B.D. of Saarbrücken include the network on the coalfield of the Saar Basin, and a heavy industrial traffic is carried by the lines radiating to the north and north-east. Owing to the relatively high relief these railways are controlled in their general pattern by the pattern of the deep-set valleys. Across the hills, and their neighbours to the north, cross-lines link the railways of the Lower Rhineland with those of the Saar and eastern France. The southern sector of Mainz R.B.D. controls the lines on both banks of the Rhine, in the upper part of the Rhine gorge as well as in the approach to it through the plain lying around the Main confluence.

The R.B.D. of Karlsruhe lies entirely within this region, apart from tentacles reaching out north-east to Würzburg and south-east to the shores of Lake Constance. From a 'spine' running from Mannheim to Basel short 'ribs' reach to bridging points over the Rhine and longer 'ribs' reach across to the Neckar Scarplands and across the watersheds of the Black Forest and the Swabian Jura to the Bavarian Foreland. With a difficult path for the rails to follow, necessitating many bridges and tunnels, this operating district links at many points with lines of the Stuttgart R.B.D. and so effectively joins the Upper Rhineland with Bavaria.

Engineering Structures

The many watersheds crossed and the great number of narrow, deeply incised valleys traversed has demanded the construction of almost innumerable tunnels and bridges.

Principal Bridges

No. on map	Bridge	Over	Date built	Total length, ft.	No. of tracks	Construction
26	—	Herchen-bachtal	1902–3	525	?	Brick arches faced with sandstone
27	Rüdesheim	R. Rhine	1913–15	2,583	2	Steel spans
28	Mainz	R. Rhine	1904	3,002	2	,, ,,
29	Mainz	R. Rhine	1910–12	3,450	2	,, ,,
30	Hochheim	R. Main	1904	958	2	,, ,,
31	Frankfurt a. M.	R. Main	1912	1,968	2	,, ,,
32	Frankfurt a. M.	R. Main	1927	929	4	,, ,,
33	Hanau	R. Main	1927	767	2	,, ,,
34	Marnheim	Valley	1874–76	853	2	,, ,,
35	Worms	R. Rhine	1898–1900	3,153	2	,, ,,
38	Ludwigshafen	R. Rhine	1932	1,312	2	,, ,,
39	Speyer	R. Rhine	1938	1,312 (over river)	1	,, ,,
40	Germersheim	R. Rhine	1875–78	1,043	2	,, ,,
41	Maxau	R. Rhine	1938	1,180	2	,, ,,
42	Wintersdorf	R. Rhine	?	1,870	2	,, ,,
43	Kehl	R. Rhine	*	892	2	,, ,,
47	Breisach	R. Rhine	1876–77	1,134	1	,, ,,
48	Neuenburg	R. Rhine	1876–77 1907–08	1,150	1 1	Two parallel bridges steel spans
49	Weil	R. Rhine	1877 1905–6	979	1 1	Two parallel bridges steel spans
50	Waldshut	R. Rhine	?	581	1	Steel spans
51	Kirchzaten	River	?	394	?	?
52	Kappel	Gutach	1899–1901	446	1	Sandstone arches
53	Höllental	Ravenna Gorge	1887, rebuilt 1927	728	?	Stone arches
54	—	Schwande-holzdobel	1899–1901	387	1	Sandstone arch
55	—	Mauchach	1899–1901	485	1	Sandstone arches
46	Hornberg	Valley	1924–26	574	3	Granite arches
45	Freudenstadt	Lautertal	1886	695	1	Steel spans
44	Forbach	Murgtal	1913–14	492	1	Granite arches

* Damaged 1939–40; since repaired.

From official sources.

The location of these bridges is shown in Figs. 51, 117, 118.

Railway Operating Features

The location of the chief marshalling yards reveals the nodal operating points. The larger yards are situated at Saarbrücken,

Kaiserslautern, Mannheim, Ludwigshafen, Karlsruhe, Offenburg and Basel. These yards are so situated as to tap either the Saar coal traffic or the more general traffic entering and leaving the trunk route from Mannheim to Basel by important transverse lines. Others are situated at such points as Worms, Landau, Freiburg and Wolf-Leopoldshöhe (Basel).

Repair shops are found at Karlsruhe (rolling stock), Offenburg (locomotives), and Schwetzingen (wagons), while in the Saar district these repair centres are more frequent, being situated at Kaiserslautern (locomotives and wagons), Saarbrücken-Burbach (rolling stock), St Wendel (locomotives), Trier (including the Wagon Department at Konz—locomotives).

Traffic

Passenger Traffic. The movement of passenger trains is dominated by the alignment of the Rhine valley and the position of the big centres of population in the region. Traffic moves in and out to the north-west and north-east, mainly through the important centres of Mainz and Frankfurt, and south to Karlsruhe and Basel. The frequency of trains decreases southwards. Of the routes south of Mainz and Frankfurt, the line through Darmstadt carries about 45 trains daily, the line through Worms about 36, and the line through Biblis 30. The converging point for these trains is Mannheim, where some leave the main valley by the Neckar route to Stuttgart.

Bridges across the Rhine do not all carry a heavy passenger traffic: the daily number of crossings increases northwards from 4 trains at Kehl to about 12 trains at Wörth, about 10 at Germersheim, 30 at Mannheim, 25 at Hofheim, and 33 at Mainz.

In the west Saarbrücken is a centre of traffic: the line through Kaiserslautern is more used by passenger trains than the main alternatives through Biebermühle, Kirn and Kochem.

Goods Traffic. This Upper Rhineland region includes the traffic districts of Baden, Mannheim and Ludwigshafen, Hesse, Frankfurt-am-Main, Bavarian Palatinate and the Saar (see p. 343) with little overlap of the districts into areas treated elsewhere in this account, except for a considerable extension into the region by the traffic districts of 'Rhine Province, west of the Rhine' and Württemberg, which are dealt with on p. 315 and p. 356 respectively.

The flow of traffic is principally along the valley of the Rhine, with considerable though subsidiary movements inwards from the Saar via Kaiserslautern, outwards to central Germany and in both direc-

tions south-east to and through Stuttgart. The greatest artery of traffic is the line from Mainz and Frankfurt to Karlsruhe and on to the south.

As the following table shows, the traffic between the districts is fairly evenly balanced. The city of Frankfurt-am-Main has, like most cities, more unloadings than loadings, while the loadings in the Saar coal area are double the unloadings. The Saar, owing to its frontier

Traffic 1936 (*thousands of tons*)

District	Local	Loaded to	Unloaded from	Loaded to	Unloaded from
		other German districts		foreign countries	
Baden	3,970	3,927	3,741	562	141
Mannheim and Ludwigshafen	457	3,968	2,711	129	43
Hesse	915	2,427	2,480	27	37
Frankfurt-am-Main	461	943	2,304	17	52
Bavarian Palatinate	1,053	2,110	2,394	68	86
Saar	7,357	5,476	2,570	3,018	5,986

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1936*, Heft I, II, *passim.*

position and relation to iron-ore deposits in foreign states, has an enormous unloading movement in the foreign trade, nearly double the loading, despite the heavy coal shipments abroad.

Route Descriptions

(23) Saarbrücken—Mannheim
(24) Saarbrücken—Kirn—Bingerbrück
(25) Saarbrücken—Trier
(26) Basel—Freiburg—Offenburg—Appenweier
(27) Freiburg—Tuttlingen
(28) Appenweier—Karlsruhe
(29) Karlsruhe—Friedrichstadt—Darmstadt—Frankfurt-am-Main
(30) Ludwigshafen—Worms—Mainz

(23) *Saarbrücken—Mannheim*

Length: Saarbrücken to Kaiserslautern, 64·1 km. (39·8 miles);
Kaiserslautern to Mannheim, 67·1 km. (41·7 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 100 (minimum radius of curves, 275 m.).
Traction: Steam.

Maximum distance between stations: Kaiserslautern to Althochspeyer, 8·7 km. (5·4 miles).

Marshalling yards: Saarbrücken, Kaiserslautern, Neustadt, Ludwigshafen, Mannheim.

Locomotive sheds: Saarbrücken, Homburg, Kaiserslautern, Neustadt, Ludwigshafen, Mannheim.

Mileage datum: Saarbrücken.

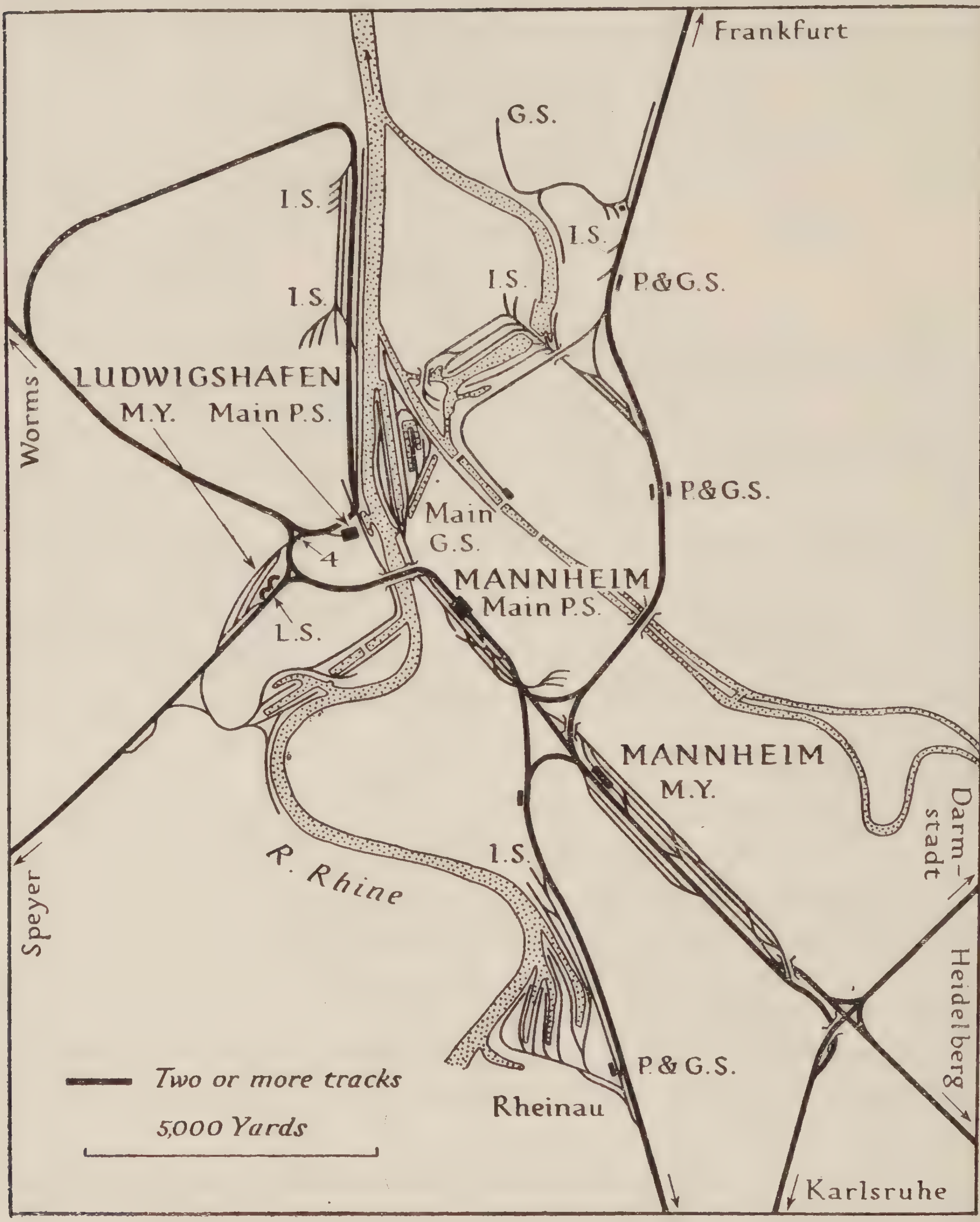


Fig. 81. Railway facilities of Mannheim-Ludwigshafen

Based on official sources.

G.S. Goods Station; I.S. Industrial sidings; M.Y. Marshalling yard; P. & G.S. Passenger and goods station. A section of 4 tracks is shown by the figure 4. The waterway port and chief industrial sites are shown on Fig. 131.

The line provides one of three links between the Saar coal basin and the Upper Rhineland. The daily capacity of trains is 60 each way, each hauling about 400 tons net load to Kaiserslautern and 72 trains of about 475 tons load beyond.

From Saarbrücken the railway follows valleys across the high ground between the Blies and Saar rivers to Limbach (23·9 km.—14·8 miles), branching on the way from a line which runs through Zweibrücken and Biebermühle to the Rhine valley at Landau. After Homburg it crosses a watershed to reach Kaiserslautern (64·1 km.—39·8 miles), which lies in a hollow between the Pfälzer Bergland and Frankweide uplands. From Kaiserslautern the line, crossing the waterparting by Hethgenberg tunnel (about 4,260 ft. long), enters the Hochspeyer valley. In its rapid descent eastwards alongside this much meandering and incised river the railway employs six tunnels (up to about 2,000 ft. in length) between Frankenstein (78·6 km.—48·8 miles) and Neustadt (96·5 km.—59·9 miles). From Neustadt the railway runs north-east across the terrace to Schifferstadt (113·6 km.—70·5 miles) and then turns to Ludwigshafen and crosses the Rhine by a 1,300-ft. bridge to Mannheim on the opposite bank.

(24) *Saarbrücken—Kirn—Bingerbrück*

Length: 141·9 km. (88·2 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 50 (minimum radius of curves, 275 m.).
Traction: Steam.
Maximum distance between stations: Idar Oberstein to Nahbollenbach, 4·1 km. (2·5 miles).
Marshalling yards: Saarbrücken, Neunkirchen, Bingerbrück.
Locomotive sheds: Saarbrücken (2), Neunkirchen, Bingerbrück.
Mileage datum: Saarbrücken.

This route provides a way between the Saar area and the head of the Rhine gorge. The daily capacity of the line is about 60 trains a day with a net load of 400 to 500 tons.

From Saarbrücken the line proceeds north-east to Neunkirchen (21·3 km.—13·2 miles) and then enters the Northern Palatinate Hills. Turning north, it crosses and re-crosses the Blies river, passing through two tunnels before Ottweiler (27·0 km.—16·8 miles). Continuing to rise alongside the Blies as far as Baltersweiler (38·6 km.—24·0 miles), the railway then crosses the waterparting to the Nahe valley, which it follows to its mouth and so gains relatively easy gradients at the cost of many bridges. Near Hoppstadten (51·1 km.—

36·1 miles) two tunnels save excessively long detours round the more pronounced meander loops. At Laubenheim (135·9 km.—84·4 miles) a line takes off and crosses the Rhine by the Hindenburg bridge, 3,527 ft. long, to Rüdesheim (146·9 km.—91·3 miles).

(25) *Saarbrücken—Trier*

Length: 88·3 km. (54·8 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 128 (minimum radius of curves, 300 m.).
Traction: Steam.
Maximum distance between stations: Taben to Serrig, 6·2 km. (3·8 miles).
Marshalling yards: Saarbrücken, Trier.
Locomotive sheds: Saarbrücken, Völklingen, Dillingen, Merzig, Karthaus, Trier.
Mileage datum: Saarbrücken.

The Saar valley, from the mining area to its junction with the Mosel, provides an essential link between the Saar and Koblenz. This line can accommodate daily about 60 trains each way each with a net load of about 425 tons.

All the way from Saarbrücken to Konz (at the Mosel confluence) the line keeps on the east bank of the Saar. At first the valley floor is relatively broad and open, but it narrows after Besseringen. Between Besseringen (44·4 km.—27·6 miles) and Mettlach (46·6 km.—28·9 miles) a detour around the long narrow Klef meander is avoided by the St Gangolf tunnel (4,265 ft.). At Konz (79·2 km.—49·2 miles) the railway turns and follows the east bank of the Mosel, here an open valley, to Trier, joining the important lines from Luxembourg and from Metz.

(26) *Basel—Freiburg—Offenburg—Appenweier*

Length: 132·2 km. (82 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 165 (minimum radius of curves, 300 m.).
Traction: Steam.
Maximum distance between stations: Freiburg (Breisgau) Hbf. to Gündelfingen, 5·6 km. (3·5 miles).
Marshalling yards: Basel, Freiburg, Offenburg.
Locomotive sheds: Basel (D.R.B.), Haltingen, Freiburg (2), Offenburg.
Mileage datum: Basel (D.R.B.).

This route provides most of the only direct connexion between Switzerland and Frankfurt-am-Main and is one of the oldest German trunk lines. The daily capacity of the line is high, with 72 trains of 500 tons net load each way.

The exit from Basel is difficult, for there are ten bridges over the

river Wiese for the main line and connexions to the yards; each bridge has a span of about 260 ft. Turning west, the line runs between the foothills of the Black Forest and the Rhine until the plain opens out near Bellingen (22·9 km.—14·2 miles). This section has necessitated three tunnels, each up to 985 ft. long, through projecting spurs. The railway north of Schliengen (26·5 km.—16·4 miles) drops down to the Rhine terrace, and swings east opposite the Kaiserstuhl to enter Freiburg (62·5 km.—38·8 miles). At this place the line serving the town deviates, while through passenger and goods trains run by an avoiding line, 2·4 km. longer, from Leutersberg to Gündelfingen. The whole way between Basel and Appenweier the line has continually to cross right-bank tributaries of the Rhine and the more important side valleys often provide a route for a branch railway; the Sam river on which Freiburg stands is an example.

To the north the railway turns west with the closing in of a re-entrant, and at Riegel (83·9 km.—52·1 miles) puts out two connexions to the bridge at Breisach, taking advantage of the firm ground formed by the lower slopes of the Kaiserstuhl. North of Riegel the railway runs due north along the foot of the Black Forest to Appenweier, to meet lines running north to Karlsruhe and west to Kehl and Strasbourg.

(27) *Freiburg—Tuttlingen*

Length: Freiburg to Donaueschingen (Höllental Bahn), 81·9 km. (50·9 miles);
Donaueschingen to Tuttlingen, 29·7 km. (18·4 miles).
Track: Freiburg to Hüfingen, single;
Hüfingen to Tuttlingen, double.
Maximum permissible axle-load:
Freiburg to Neustadt, 20 tons;
Neustadt to Donaueschingen, 16 tons;
Donaueschingen to Tuttlingen, 20 tons.
Maximum gradient: Hirschsprung to Hinterzarten, 1 in 18;
Rest of line Freiburg to Donaueschingen, 1 in 40.
(Minimum radius of curves, 225 m.)
Traction: Electric between Freiburg and Neustadt; remainder of route, steam.
Maximum distance between stations: Hölsteig to Hinterzarten, 6·5 km. (4·0 miles).
Marshalling yards: Freiburg.
Locomotive sheds: Freiburg, Villingen.
Mileage datum: Freiburg (Breisgau).

This line, linking the Rhine and the Danube, is one of the most heavily graded in Germany (see p. 272). Originally it was worked by a rack system (between Hirschsprung and Hinterzarten, where gradients of 1 in 18 are found), but on electrification the rack was dismantled. A difficult line to build, the track up the Höllental valley passes through twelve tunnels, of a total length of over 2 km.,

and several bridges had to be constructed in this section. The line is also difficult to work, and even with electric locomotives 12 trains each way with a net load of 100 tons is the most that can be carried. If electricity were unobtainable, steam locomotives would be unable to surmount the gradient without a rack system.

Leaving Freiburg (Breisgau), which lies at an altitude of 882 ft., the railway rises 403 ft. to Kirchzarten (10·9 km.—6·7 miles) and a further 207 ft. to Himmelreich (13·9 km.—8·6 miles). Here it leaves the Rot valley and enters the hilly region of Höllental and the rapid increase of height may be summarized as follows:

Station	Distance		Height, ft.	Average gradient
	km.	miles		
Hirschsprung	18·2	11·3	1,834	
				1 in 48
Posthalde	22·9	14·2	2,155	
				1 in 20
Hölsteig	26·1	16·2	2,677	
				1 in 94
Hinterzarten	32·6	20·2	2,903	

Hinterzarten is usually the locomotive-changing point and the most powerful electric locomotives take the west-bound trains down the heavy grades to Freiburg.

From Hinterzarten the line drops down the Gutach valley to Neustadt (Schwarz) (42·0 km.—26·1 miles), which lies at an altitude of 2,641 ft. Leaving the Gutach near Kappel (46·3 km.—28·7 miles), the railway turns up a tributary valley and switchbacks across several headstream valleys to Hüfingen (79·3 km.—49·2 miles) before descending beside the Brege river to Donaueschingen (81·9 km.—50·9 miles) on the Danube. From here the railway runs alternately on either bank of the Danube to Tuttlingen (111·6 km.—69·2 miles), where it connects with routes to Ulm and Stuttgart and so with Bavaria.

(28) *Appenweier—Karlsruhe*

Length: 63·0 km. (39·1 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: About 1 in 80 (minimum radius of curves, 210 m.).
Traction: Steam.
Maximum distance between stations: Muggensturm to Malsch, 6·1 km. (3·8 miles).
Marshalling yard: Karlsruhe.
Locomotive sheds: Karlsruhe.
Mileage datum: Appenweier.

Forming part of the main line along the Rhine valley, this section of line has a high daily capacity each way with 72 trains, each of

about 425 tons net load. The line runs along the upper terrace of the Rhine, thus avoiding the floodplain, through the important junction of Rastatt (40·4 km.—25·1 miles), and then swings east and north to enter Karlsruhe. An alternative line between Rastatt and Karlsruhe runs through Bietigheim on the west side of Hardt Wald.

(29) *Karlsruhe—Darmstadt—Frankfurt-am-Main*

Length: 133·9 km. (82·5 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 80 (minimum radius of curves, 350 m.).
Traction: Steam.
Maximum distance between stations: Graben-Neudorf to Wiesental, 7·2 km. (4·4 miles).
Marshalling yards: Karlsruhe, Mannheim, Darmstadt, Frankfurt-am-Main.
Locomotive sheds: Karlsruhe, Graben-Neudorf, Mannheim, Weinheim, Darmstadt, Frankfurt.
Mileage datum: Karlsruhe.

This line is part of a main north-south trunk route; the daily capacity is high, with 72 trains each way each carrying a net load of 500 tons. From Karlsruhe the line runs halfway between the Neckar Scarplands and the Rhine, and has to cross many tributary streams before reaching Friedrichsfeld (53·6 km.—33·2 miles) where it crosses the direct Mannheim to Heidelberg line. From Friedrichsfeld the railway turns to the north-east and crosses the Neckar before entering Ladenburg (56·8 km.—35·2 miles). From this point it runs along the Bergstrasse terrace, at the western foot of the Odenwald, and just beyond the northern tip of this upland mass reaches Darmstadt (103·7 km.—64·4 miles). Proceeding dead straight across the Lower Main Plain, with the more undulating part of the plain to the east, the line passes through the southern suburbs of Frankfurt and, crossing the Main by a bridge 930 ft. long, enters the main station at Frankfurt (133·9 km.—83·2 miles).

(30) *Ludwigshafen—Worms—Mainz*

Length: 67·5 km. (41·9 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 80 (minimum radius of curves, 350 m.).
Traction: Steam.
Maximum distance between stations: Worms to Osthofen, 8·2 km. (5·1 miles).
Marshalling yards: Ludwigshafen, Mainz-Bischofsheim.
Locomotive sheds: Ludwigshafen, Worms, Mainz Hbf.
Mileage datum: Ludwigshafen.

The daily capacity of the line is as great as that of the parallel route

from Mannheim to Frankfurt, viz., 72 trains each way, each with a net load of 500 tons.

After leaving Ludwigshafen, the line runs west and north to Frankenthal (10·7 km.—6·6 miles) and so avoids the land liable to floods north of Ludwigshafen. From Frankenthal it proceeds north through Worms (21·3 km.—13·2 miles) and along the edge of the floodplain where rising ground begins to Rhenish Hesse. At Oppenheim (47·1 km.—29·2 miles) the Rhine skirts this upland, but there is sufficient lowland for the railway to continue without tunnelling. The railway enters Mainz Hbf. by a curved tunnel 3,914 ft. long, necessitated by the close approach to the Rhine of the outlying uplands of Hesse and by the need to swing inland so as to turn for the crossing of the Rhine.

South Germany

This region, centred on Nuremberg, extends from Frankfurt-am-Main to Hof and the frontier of Bohemia in the north and from Friedrichshafen to Passau and the frontier of Austria in the south. The routes, many of which are of international importance, are dominated by the number of important nodal points at which several routes meet: such nuclei are Stuttgart, Nuremberg, Augsburg and Munich. The principal north-south lines are those passing to Innsbrück and Salzburg in Austria from central Germany, whilst there are several east-west lines through Munich, Ulm, Stuttgart, Nuremberg and Würzburg. The frontier crossings into Austria, from west to east, occur at Lindau, Pfronten-Steinach, Griesen, Mittenwald, Kufstein (Austria), Schellenberg, Freilassing, Simbach and Passau. Into Czechoslovakia, from south to north, the crossings are situated at Haidmühle, Eisenstein, Furth, Eger (in Bohemia), on which five routes converge: Klingenth Johgeorg, Weipert, Reitzenhain and Moldau. The most important of the routes into Bohemia are those passing through Furth and Eger.

Physical Background

In the northern zone of south Germany the low but steep sandstone and limestone ridges alternate with clay vales. East of Schweinfurt sandstones predominate, rising to a north-west facing scarp, while to the west is the limestone Lower Franconian plateau with deeply incised rivers whose valleys are followed by railways. The rivers of the eastern sandstone zone drain to the Regnitz, which flows to a T-junction with the Main, and the through route so formed provides

a path for the electrified main line between Lichtenfels and Nuremberg. To the east is the long narrow Main-Naab 'corridor' between the Fichtel Gebirge and the Franconian Jura; the chief railway town of this routeway is Bayreuth. The Fichtel Gebirge, despite their height and ruggedness and generally repellent character, are crossed by the principal routes between the Main basin and western Bohemia and so form a key zone in the railway communications of south Germany.

On the other side of the Main-Naab corridor the Franconian Jura rise gently and culminate in a crescentric north—and west—facing scarp overlooking the basin of the Regnitz. This scarp face is much broken and so can be crossed by railways running east and south from Nuremberg. At the western end of the Franconian Jura, separating it from the Swabian Jura, is the depression of the Ries basin known as the Nördlingen 'gate', from the town of that name which has five railways radiating from it. This gap provides the best graded railway route from the Neckar and Main basins to the Danube basin. The Swabian Jura rise higher than the Franconian, but nevertheless are crossed by several railways from the Neckar scarplands (see p. 338).

South of the Jura is the Bavarian Foreland which rises to the Bavarian Alps. This extensive region, 200 miles from east to west and up to 80 miles wide, slopes gently from an altitude of about 3,000 ft., in the south to the Danube valley at about 1,000 ft. The relief, in detail, is greatly varied owing to the numerous glacial deposits. Some of these deposits form hills and others marshes, both of which provide obstacles to railway construction, while others, such as the gravel plain which centres on Munich, have facilitated building. The numerous eastward- and northward-flowing streams are bordered by gravel terraces forming firm ground, overlooking the marshes and peatbogs of the floodplains, and on this firm ground the railways are laid. The two great centres of railway activity in this zone are Munich and Augsburg. Rising above this foreland belt, which has the greatest mileage of electrified line in Germany, are the Bavarian Alps which form German territory as far as the crestline. North of the main range are parallel lower ridges. The rivers which rise in the main range have cut narrow gorges through these parallel ridges and so railway construction has been difficult. Numerous railways penetrate into these valleys, but only two important ones, at Mittenwald and Kufstein, cross the watershed. In the north-east the Foreland is bounded by the rugged mountain ridges of the Bavarian

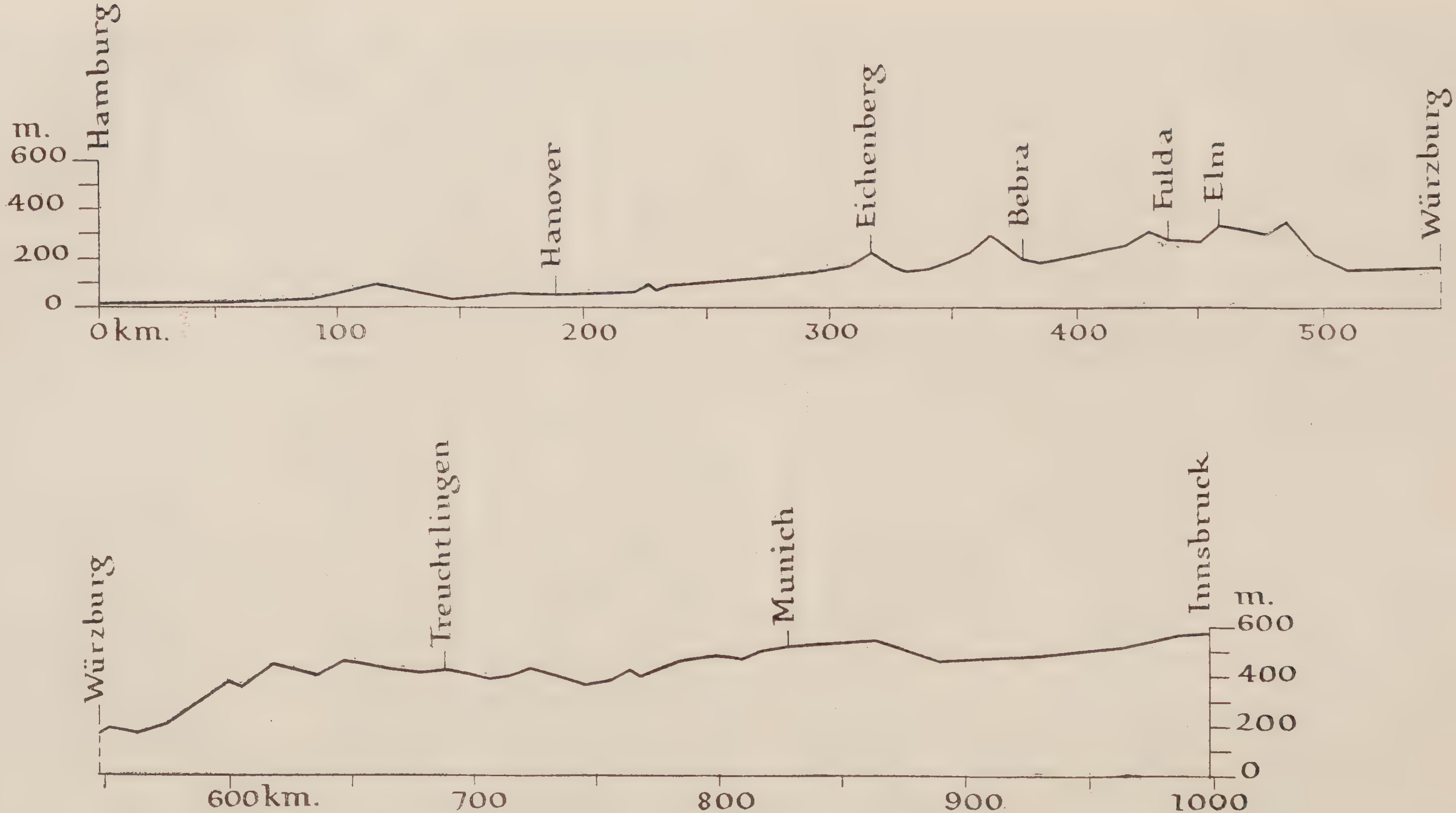


Fig. 82. Gradient profile, Hamburg—Bebra—Würzburg—Innsbruck (Austria)

Based on Blum, —, 'Trassierungs-Grundsätze für Eisenbahnen ausserhalb der hoch-industrialisierten Gebiete', *Verkehrstechnische Woche*, 27th year, Heft 38, pp. 552–60 (Berlin, 1933).

Vertical exaggeration approximately 100 times.

Fig. 83. The railways of south Germany

Based on G.S.G.S. Series 4072, Europe (Air), 1 : 500,000, Sheets N.E. 50/6, N.E. 50/10, N.E. 48/6, N.E. 48/10, N.E. 46/6, N.E. 46/10 (1940–2), and other official sources.

For key to symbols see Fig. 68.

Forest, which is separated from the higher Bohemian Forest by a long valley cut by the Regen, a tributary of the Danube. This double rampart of south-eastern Bohemia is only crossed by the railways which run through Furth, Zwiesel and Waldkirchen. The Regen valley does not continue, and to get by rail from Furth to Waldkirchen a circuitous route, with horseshoe loops on the slopes of Einöd Riegel, through Deggendorf, has to be used.

Railway Divisions

This region is covered by the whole of the operating divisions of Munich, Augsburg and Regensburg, the greater part of the Stuttgart and Nuremberg districts, and small portions of Dresden and Erfurt districts.

The R.B.D.s of Munich and Augsburg occupy the Bavarian Foreland and the Bavarian Alps. Lines radiate on the Foreland from a great number of centres of which the leading are Augsburg and Munich, while the Danube valley is paralleled by a main line between Ulm and Ingolstadt. A feature of the network in these R.B.D.s is the considerable amount of electrification.

The R.B.D. of Stuttgart, lying across the Swabian Jura, has a sparse network except round Stuttgart itself. The Danube is followed upstream from Ulm to Tuttlingen. Regensburg R.B.D. runs north from Passau to Oelsnitz Hof and so parallels the south-eastern side of the Bohemian 'diamond', and crosses from the Bavarian Foreland into the Bavarian Forest, the Bohemian Forest, the edge of the Franconian Jura, the Main-Naab corridor, and the Fichtel Gebirge. In the south the main railway from Ingolstadt through Regensburg to Passau follows the Danube on its southern bank and so avoids the Bavarian Forest uplands. Further north branches from the main north-south line, through Regensburg, runs eastwards into the valleys of the Bohemian Forest and Fichtel Gebirge.

Nuremberg R.B.D. lies in the Franconian Jura, Main Scarplands and Main-Naab corridor and forms a key zone between the industrial area of Central Germany and Austria. Of the cross-lines the most important is that from Aschaffenburg through Schweinfurt to Bayreuth along the valley of the Main.

The southern corners of the Dresden and Erfurt R.B.D.s are relatively isolated from their main centres.

Engineering Structures

Despite the high general relief there are comparatively few tunnels

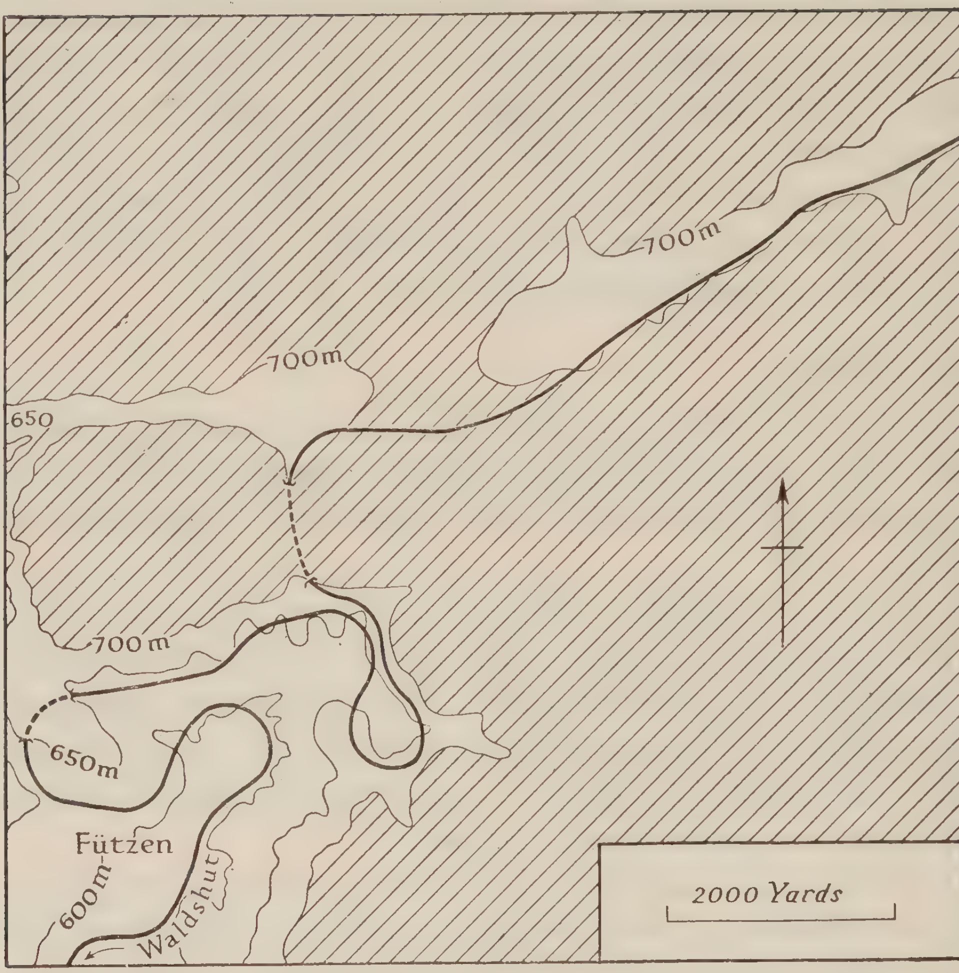


Fig. 84. Loops and tunnels on the Waldshut-Immendingen railway

Based on G.S.G.S. Series 4414, 1 : 25,000, Sheet 8117.

This single-track line branches from the Tuttlingen-Donaueschingen double-track line near Geisingen. It is seen in the north-east of the map ascending the narrow valley of the Aitrach, a small northward-flowing tributary of the Danube. It turns south through a tunnel under the Kleiner Buchberg to descend into the valley of the Muhl Bach by three loops and a further tunnel. To the south of Fützen the descent requires a spiral tunnel, after which the line enters the valley of the Wutach (a tributary of the Rhine from the south-east slopes of the Black Forest) and descends this after a northward loop and further tunnel.

as the passes are low and the wide glaciated valleys provide space for a railway track. Large bridges are found on the headwaters of the various north-flowing rivers from the Bavarian Alps where they are crossed by east-west lines. (See table on opposite page.)

Railway Operating Features

The paucity of goods traffic is shown by the small number of large marshalling yards: these are principally confined to the main junctions, viz., Munich, Augsburg, Ulm, Regensburg, Nuremberg, Heilbronn and Würzburg. Further yards for goods marshalling

Principal Bridges

No. on map	Bridge	Over	Date built	Total length, ft.	No. of tracks	Construction
36	Hetzbach	Himbachel	?	?	2	Stone or brick arches
37	Langenbrand	Valley	1908–10	489	2	Granite arches
69	—	Kramper Schlucht	1929	317	?	?
68	Bietigheim	Enztal	1854	938	1	Stone arches
67	Münster	R. Neckar	1896–1904	2,214	2	Steel spans
66	Stuttgart	Englischer Garten, Stuttgart	1912	1,509	2	Reinforced concrete frame construction
65	Neustadt	R. Rems	1876	787	1	Steel spans
64	Cannstatt	R. Neckar	1911	1,060	2	Concrete arches
63	—	Strümpfelbachtal	1908	394	?	,, ,,
62	Ulm	R. Donau	?	492*	2	Stone or brick arches
56	Konstanz	R. Rhien	1861–3	459	2	Steel arches
57	Kempten	R. Iller	1905	499	2	Concrete arches
57	Kempten	R. Iller	1905	499	2	,, ,,
61	Hochzoll	R. Lech	1925–6	410	2	Steel span
60	Grosshesselohe	R. Isar	1909	879	2	Steel girders
59	Königswart	R. Inn	1874–6	856	1	Steel spans
70	Kitzingen	R. Main	1894	590*	2	Limestone arches
79	Hof	R. Saale	1845	656	2	Stone arches

* Approximate. The location of these bridges is shown in Fig. 51.

From official sources.

are found at Frankfurt-am-Main, Hof, Hanau, Darmstadt, Aschaffenburg, Coburg, Hof, Bamberg, Jagstfeld, Plochingen, Ulm, and Munich-Laim.

Railway repair shops are situated at Ingolstadt (locomotives), Munich-Freimann (steam and electric locomotives and other rolling stock), Neuaubing (coaches), Augsburg (wagons), Nuremberg (locomotives and other rolling stock), Weiden (locomotives and wagons), Aalem (locomotives and wagons), Esslingen (locomotives), Friedrichshafen (locomotives and wagons), Stuttgart-Bad Cannstatt (rolling stock), Stuttgart-North (wagons), Heilbronn (repair of points, etc.).

Traffic

Passenger Traffic. With many cross-country services connecting with each other at the numerous junctions there is no one major artery of traffic. Individual cities such as Munich have a great

number of trains arriving and departing, but at Munich these trains are spread over eight main lines and eight minor lines, within a short distance, so that the city fails to appear on a line of heavy traffic. The densest traffic is found between Treuchtlingen and Donauwörth, and reaches about 25 trains a day. Even in the north-west, where the region cuts into the traffic between Berlin and Frankfurt-am-Main, the number of trains east of Hanau barely exceeds 20. Over the Austrian frontier 9 trains cross at Mittenwald, 22 at Kufstein, 14 at Freilassing, 6 at Simbach and 15 at Passau.

Goods Traffic. This region includes the industrial area around Stuttgart in the west and smaller industrial centres of Nuremberg and Munich in the east. Rarely do any of the lines carry a heavy mineral and goods traffic. The lines responsible for the greatest tonnage are those from Stuttgart to Mühlacker, and from Gemünden to Aschaffenburg. Elsewhere, while there are frequent junction towns carrying on an active industry, the volume of traffic leading in and out is lighter than in many other areas of Germany.

This region here described as 'South Germany' comprises the traffic districts of North Bavaria, South Bavaria, Munich and Württemberg, but there is also a portion of Baden district protruding into the north-west.

Local traffic is light, allowing for the great area of the districts. In the traffic with other districts outside the region there is much less loaded than unloaded, which is to be expected owing to the absence of bulk-producing industries such as coal-mining.

Traffic, 1936 (*in thousands of tons*)

District	Local	Loaded to	Unloaded from	Loaded to	Unloaded from
		other German districts		foreign countries	
Württemberg and Hohenzollern	3,941	2,660	8,347	84	236
N. Bavaria	6,700	4,532	8,126	125	960
S. Bavaria	5,373	4,489	6,488	54	348
Munich	81	1,012	2,682	19	232

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1936*, Heft I, II, *passim*.

While the tonnages are relatively small, interesting features are revealed by the detailed statistics. The principal 'exports' from Württemberg traffic district is iron ore; timber for building and paper follow, while there are considerable 'exports' of salt and chemicals.

'Imports' include coal, coke, lignite (briquetted to reduce transport charges), cotton from the Elbe and Weser ports, fertilizers, and iron and steel bars and ingots. From the Merseburg area comes benzin, and from Mannheim benzin and sulphuric acid.

South Bavaria traffic district has a less unbalanced wagon loading, probably because of the stimulus of industry by hydro-electricity, and of the large forests which supply good timber. The main rail 'exports' are nitrogenous fertilizer, oats and building timber, while milk is sent into Munich at the rate of 1,000 tons weekly. From the Elbe and Weser ports come, by rail, cotton, copper and oils, but of all 'imports' a dominant place is taken by coal and cement. A heavier tonnage of coal comes from Silesia, via Hof, than from the Ruhr. North Bavaria and the Rhineland supply most of the cement.

North Bavaria handles more traffic (local, other German and foreign) than any other district in the region. Among 'exports' considerable quantities of iron ore are sent to the Thuringian, Ruhr and Saar industrial areas, and quantities of building stone and sand to the urban areas. 'Imports' include chemicals and benzin coal (principally from the Ruhr), cement, copper ores, fertilizers and meal.

Munich has no single significant 'export' except for over 300,000 tons of sand, derived from the fluvioglacial deposits and dispatched to the South Bavarian traffic district. 'Imports', apart from solid and liquid fuel, include bar iron and tubes from the Saar, sheet steel from North Bavaria and cement from Württemberg and North Bavaria.

The only bulk foreign imports are vegetables and fruit from Italy, France and the Iberian peninsula.

The railway goods traffic of south Germany may be illustrated by a summary of the larger items in the movement to and from the district (No. 36) which is called, in the railway traffic returns, 'South Bavaria' (Fig. 63). (See table on page 358.)

Route descriptions

(31) Frankfurt-am-Main—Aschaffenburg—Gemünden—Würzburg
(32) Würzburg—Nuremberg
(33) Nuremberg—Regensburg—Passau
(34) Würzburg—Schweinfurt—Bamberg
(35) Hof—Bamberg—Nuremberg
(36) Nuremberg—Eger (Cheb, Czechoslovakia)
(37) Hof—Regensburg—Munich
(38) Mannheim—Osterburken
(39) Grötzingen—Bretten—Heilbronn—Nuremberg

Goods Traffic of South Bavaria, 1936 (*by traffic districts to or from which commodity items of* 50,000 *tons or more were despatched or received, in thousands of tons*)

	Outwards from District 36	Inwards to District 36
Upper Silesia	—	Coal (384·1)
Lower Silesia	—	Coal (18·1), coke (127·4)
Merseburg and Erfurt	—	Lignite briquettes (163·8)
Thuringia	—	Lignite briquettes (135·6), salt (59·2), potash fertilizer (93·1)
Saxony	—	Lignite briquettes (53·1)
Westphalian Ruhr	—	Coal (200·9), coal briquettes (54·9), coke (133·3)
Rhine prov., Ruhr	—	Coal (50·4)
Westphalia	Building timber (51·0)	—
Rhine prov., E. of Rhine	—	Artificial stone (55·1)
Rhine prov., W. of Rhine	—	Coal (110·8), lignite briquettes (167·5)
Saar	—	Coal (165·3), basic slag (89·8)
Munich	Milk (65·3), lignite (370·9), worked stone (124·5), sand (52·2), artificial stone (51·6)	Sand (377·6)
North Bavaria	Oats (71·5), worked stone (200·2), sand (298·2), building timber (54·8), artificial stone (87·9)	Coal (54·6), worked stone (300·4), cement (155·1)
Czechoslovakia	—	Coal (79·8), lignite (53·1)

From: *Die Güterbewegung auf deutschen Eisenbahnen 1936*, Heft. I, II, *passim* (Berlin, 1937).

(40) Heilbronn—Osterburken—Lauda—Würzburg
(41) Karlsruhe—Stuttgart—Ulm—Munich
(42) Munich—Salzburg (Austria)
(43) Munich—Innsbruck (Austria)
(44) Nuremberg—Augsburg—Kempten—Lindau
(45) Kempten (Allgau)—Neu Ulm
(46) Treuchtlingen—Ingolstadt—Munich
(47) Tuttlingen—Ulm

The above routes do not exhaust the great number available. With many separate junction towns radiating lines in all directions, the railways of south Germany do not present a pattern of well-marked trunk routes, like the networks of other regions. The above selection has been made to cover the more important combinations of routes possible.

(31) *Frankfurt-am-Main—Aschaffenburg—Gemünden—Würzburg*

Length: 132·5 km. (82·5 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 70 (minimum radius of curves, 300 m.)
Traction: Steam.
Maximum distance between stations: Laufach to Heigenbrücken, 7·9 km. (4·9 miles).
Marshalling yards: Frankfurt, Aschaffenburg, Würzburg.
Locomotive sheds: Frankfurt (2), Hanau, Aschaffenburg (2), Gemünden, Würzburg.
Mileage datum: Frankfurt Süd.

Forming a useful exit for the Rhine valley above the gorge, this line, with its junctions, provides routes to a great part of Central Germany. The daily capacity is about 60 trains each way.

Running out of Frankfurt Süd by the 1,968-ft. long Deutschherrn bridge over the river Main, the line passes along the right bank of the Main through Hanau (18·0 km.—11·1 miles) to Aschaffenburg (43·2 km.—26·8 miles). Here it uses the Aschaff valley and rises to Laufach (53·7 km.—33·3 miles) and by a tunnel one mile long cuts through the watershed to the Lohr valley. Discarding this, it joins the Main valley again at Lohr 81·1 km. (50·3 miles) and closely following its incised meanders on the right bank enters Würzburg.

(32) *Würzburg—Nuremberg*

Length: 102·2 km. (63·4 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 85 (minimum radius of curves, 300 m.).
Traction: Steam.
Maximum distance between stations: Neustadt to Elmskirchen, 9·5 km. (5·9 miles).
Marshalling yards: Würzburg, Nuremberg.
Locomotive sheds: Würzburg, Nuremberg.
Mileage datum: Würzburg Hbf.

This line provides part of the linkage between the Rhineland and Bavaria and Austria. Its capacity is 60 trains per day each way.

From the eastern suburbs of Würzburg the line proceeds across the core of the large southward loop of the Main to Kitzingen (22·9 km.—14·1 miles), where it crosses the river by a bridge about 1,300 ft. long. From here it continues in an almost straight course to Fürth and Nuremberg, crossing as it does numerous eastward-flowing tributaries of the Regnitz.

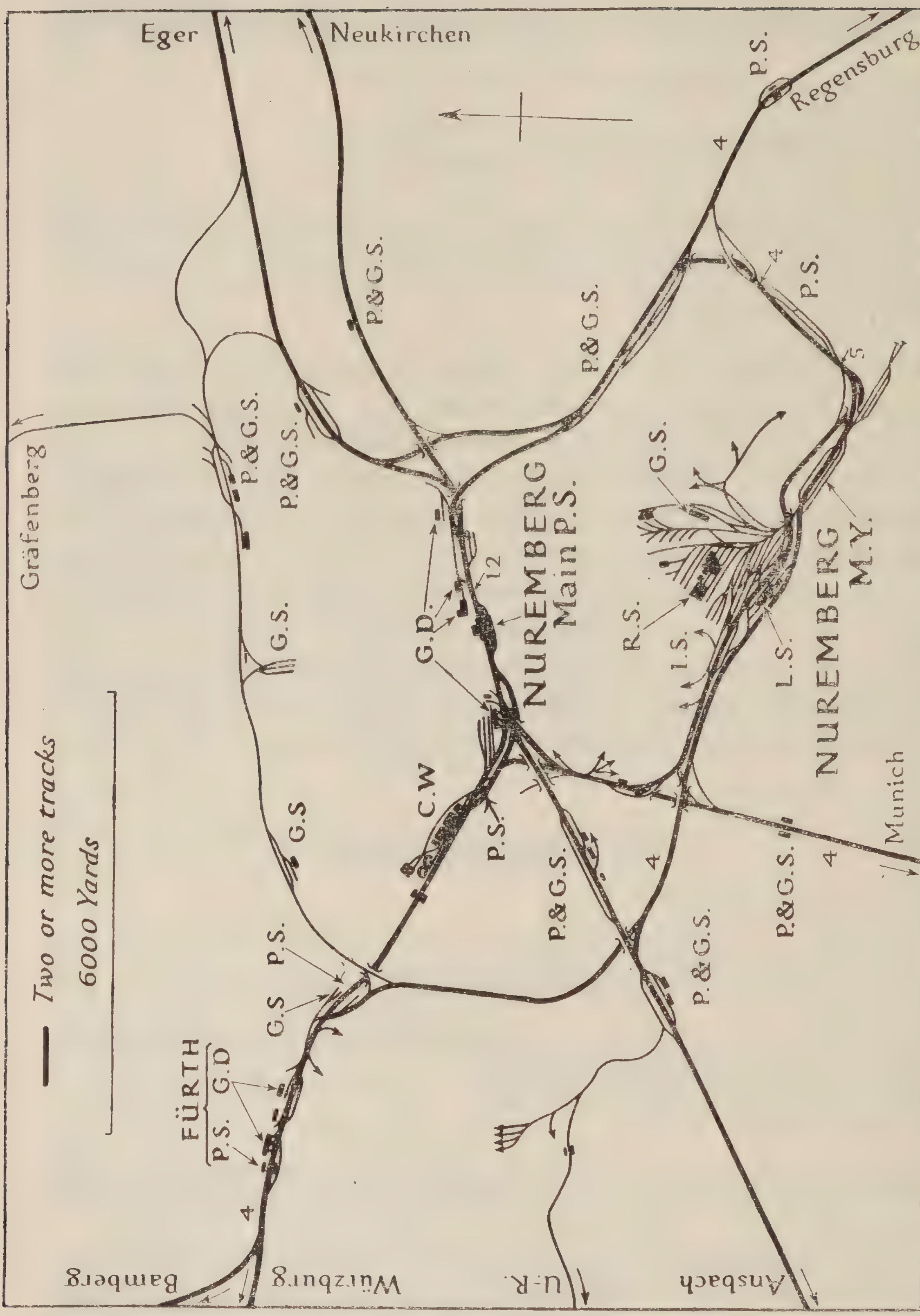


Fig. 85 Railway facilities of Nuremberg

Based on official sources.

The figures indicate the numbers of tracks where there are more than two. C.W. Carriage workshops; G.D. Goods depot; G.S. Goods station; I.S. Industrial sidings; L.S. Loco shed; M.Y. Marshalling yard; P. & G.S. Passenger and goods station; P.S. Passenger station; R.S. Repair shops; U-R Unternbibert-Rügland. There is also a loco depot to the north-west of the carriage works.

(33) *Nuremberg—Regensburg—Passau*

Length: 218·1 km. (135·5 miles).
Track: 0·0 to 0·7 km. (0 to 0·4 miles), 12-track;
0·7 to 3·3 km. (0·4 to 2·0 miles), double;
3·3 to 8·0 km. (2·0 to 4·9 miles), 4-track;
8·0 to 218·1 km. (4·9 to 135·5 miles), double.
Maximum permissible axle-load: 20 tons.
Maximum gradients: 1 in 97 (minimum radius of curves, 292 m.).
Traction: Steam.
Maximum distance between stations: Neumarkt (Oberpf.) to Deining (Oberpf.), 10·5 km. (7·1 miles).
Marshalling yards: Nuremberg, Regensburg.
Locomotive sheds: Nuremberg, Regensburg, Plattling, Passau.
Mileage datum: Nuremberg Hbf.

This line provides part of the direct line between Frankfurt-am-Main and Austria. Its capacity is 60 trains per day each way.

Leaving Nuremberg Hbf. the line proceeds south-eastwards across the wooded hills of the Franconian Jura to Regensburg. Although the line seeks as easy a path as possible there are severe gradients near Neumarkt (Oberpf.) (36·0 km.—22·3 miles). The line does not keep to any one valley until it comes to Parsberg (63·8 km.—30·6 miles), when it turns and runs down the Laaber valley to Deueling (85·5 km. —53·1 miles)—near the confluence with the Danube; here it turns more sharply eastwards than the river. Just before entering the suburbs of Regensburg the line crosses the Danube by a girder bridge (95·0 km.—59 miles), with a length, including the wide abutment arches provided to cope with heavy river floods, of about 1,300 ft.

From Regensburg the line curves south and then east to avoid the marshy floodplain of the Danube and only touches the Danube again at Straubing (141·3 km.—87·7 miles), where the river approaches high ground. From Straubing to Plattling (165·8 km.—103 miles) the line runs direct and crosses the Isar by a short bridge. Beyond Plattling the line runs along the edge of the floodplain to Pleinting (190·1 km.—118·1 miles), where it enters the narrow section of the valley in which the Danube flows between steeply rising banks. The railway clings closely to the right bank as far as Passau, where it enters Austria by a bridge over the Inn immediately before the confluence of this river with the Danube. It is in this section between Pleinting and Passau that the most heavy grading is experienced.

(34) *Würzburg—Schweinfurt—Bamberg*

Length: 100·2 km. (62·2 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.

Maximum gradient: 1 in 140 (minimum radius of curves, 330 m.).
Traction: Steam.
Maximum distance between stations: Rottendorf to Seligenstadt, 9·4 km. (5·8 miles).
Marshalling yards: Würzburg, Schweinfurt.
Locomotive sheds: Würzburg, Schweinfurt.
Mileage datum: Würzburg.

This line connects the route from Mannheim with the electrified line from the Merseburg industrial region to Austria. The daily capacity of the line is high, at 72 trains each way.

From Würzburg the line cuts across the great southern loop of the Main and only approaches the river at Schweinfurt (43·3 km.—26·8 miles), the roller- and ball-bearing manufacturing centre. Gently ascending from Schweinfurt, keeping all the way close to the northern bank of the Main, yet avoiding the floodplain which exists where the river is not deeply incised, the railway reaches Bamberg by crossing the Main near Oberhaid (92·9 km.—57·6 miles).

(35) *Hof—Bamberg—Nuremberg*

Length: 189·6 km. (117·7 miles).
Track: Double.
Maximum permissible axle-load: 20 metric tons.
Maximum gradient: 1 in 40 (minimum radius curves, 292 m.).
Traction: Hof to Hochstadt-Markzeuln, steam;
Hochstadt-Markzeuln to Nuremberg, electric.
Maximum distance between stations: Marktschorgast to Neuenmarkt-Wirsberg, 7·5 km. (4·6 miles).
Marshalling yards: Hof (Oberkotzau), Nuremberg.
Locomotive sheds: Hof, Nuremberg.
Mileage datum: Hof.

This line forms part of the main route from Berlin to Leipzig and south Germany. Its capacity is 86 trains per day each way with electric locomotives and 72 with steam.

Running from Hof up the Sachs Saale valley, the line crosses the difficult country between the Franconian Jura and the Fichtel Gebirge near Marktschorgast (54·3 km.—28 miles), and then crosses the Main-Naab 'Corridor' to Mainleus (70·6 km.—43·7 miles). For the rest of the way to Bamberg (127·2 km.—78·9 miles the river Main is followed, in its wide arc to the north, to avoid crossing the northern tip of the Franconian Jura. From Bamberg the railway runs on the east bank of the Regnitz upstream to a point near Nuremberg, to enter the city after a double crossing of the river. In this route upstream the railway avoids the floodable areas of the Regnitz and keeps on the edge of the bluffs almost the whole way.

(36) *Nuremberg—Eger (Cheb, Czechoslovakia)*

Length: 151·4 km. (94 miles).
Track: Nuremberg to Marktredwitz, double;
Marktredwitz to Eger (Cheb), single.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 80 (minimum radius curves, 300 m.).
Traction: Steam.
Maximum distance between stations: Immenreuth to Neusorg, 10·4 km. (7·0 miles).
Marshalling yards: Nuremberg.
Locomotive sheds: Nuremberg, Eger.
Mileage datum: Nuremberg Hbf.

This line provides the direct route between south Germany and Czechoslovakia and also provides a connexion to central Germany. Gradients are severe and generally against eastbound trains. The capacity of the line is 48 trains per day each way on the double-track section, and 12 on the single-track section.

Leaving Nuremberg Hbf. the line passes to the north side of Pegnitz valley by a 160-ft. bridge and runs upstream to Hohenstadt (33·6 km.—20·8 miles). From here, still following the valley through its right-angle bend, the track crosses and recrosses the many meanders of the Pegnitz and passes through several tunnels, the longest being about 1,300 ft., which cut off hill spurs. In this part of the valley the Pegnitz river is cut into the Franconian Jura Uplands. After reaching Schnabelwaid (75·0 km.—46·6 miles) the railway penetrates a watershed by a tunnel 1,300 ft. long, crosses several headwaters of the Nab river, and, running through the Fichtel Gebirge, descends by eastward-flowing tributaries of the Eger river across the frontier to Eger (Cheb). The Reichsbahn-owned metals continue into Czechoslovakian territory, and there is a German locomotive shed at Eger.

(37) *Hof—Regensburg—Munich*

Length: Hof to Regensburg, 179·2 km. (111·3 miles);
Regensburg to Munich, 138·2 km. (85·8 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 100 (minimum radius of curves, 400 m.).
Traction: Steam from Hof to Regensburg and electric from Regensburg to Munich.
Maximum distance between stations:
Wiesau to Reuth, 10·4 km. (6·4 miles);
Munich-Moosach to Munich Hbf., 9·9 km. (6·1 miles);
Marshalling yards: Hof (Oberkotzau), Regensburg, Munich (2).
Locomotive sheds: Wiesau, Schwandorf, Regensburg, Landshut, Munich (2).
Mileage datum: Hof.

This line affords a major route between south Bavaria and the industrial area of Central Germany. The capacity of the line from Hof to Regensburg is 60 trains each day each way, and from Regensburg to Munich 96 trains with electric haulage and 72 with steam haulage.

Leaving Hof, the line runs alongside the Sachs Saale river and its tributary the Lamitz into the Fichtel Gebirge. Working by the headwaters of the Eger and Nab rivers it reaches the Nab at Reuth (69·7 km.—43·2 miles), and then continues, mainly on the west bank, downstream to Schwandorf. Taking advantage of a much wider valley it proceeds direct, apart from a sharp curve round the upland at Ponholz (155·2 km.—96·4 miles), to Regensburg (179·2 km.—111·3 miles). The Danube is crossed here by a bridge, about 2,000 ft. long with a 328-ft. floodwater opening, together with a viaduct and embankment to carry the line over the floodplain. Running south through hilly country, the railway approaches the Isar river at Landshut (241·3 km.—150 miles), but instead of crossing it runs along the west bank, well away from the floodable area, and enters Munich from the west.

(38) *Mannheim—Osterburken*

Length: 101·6 km. (63 miles).
Track: Double.
Maximum permissible axle-load: Mannheim to Eberbach, 20 tons; Eberbach to Seckach, 18 tons; Seckach to Osterburken, 20 tons.
Maximum gradient: 1 in 66 (minimum radius of curves, 300 m.).
Traction: Steam.
Maximum distance between stations: Eberbach to Lindach, 6·2 km. (3·7 miles).
Marshalling yards: Mannheim, Heidelberg.
Locomotive sheds: Mannheim, Neckarelz, Heidelberg.
Mileage datum: Mannheim Hbf.

This route forms part of the main line from Mannheim to Würzburg and central Germany. The daily capacity of the line is high, at 60 to 72 trains each way.

Running through flat country on the south side of the Neckar to Heidelberg (18·2 km.—11·2 miles), gradients and curves are negligible. East of Heidelberg, however, is the Odenwald upland, and the deeply incised path of the Neckar, despite the presence, in places, of river terraces, makes a difficult route for the railway. There is a succession of tunnels through hill spurs, and bridges across marshes, from just west of Heidelberg to Osterburken. The railway follows the Neckar as far up-stream as Neckarelz (68·9 km.—42·7 miles)

and then turns north-east and uses the Elz valley and minor tributaries of the Seckach to reach Osterburken.

(39) *Grötzingen—Bretten—Heilbronn—Nuremberg*

Length: 241·3 km. (149·9 miles).
Track: Grötzingen to Bretten, single;
Bretten to Nuremberg, double.
Maximum permissible axle-load: Grötzingen to Bretten, 18 tons;
Bretten to Eppingen, 16 tons;
Eppingen to Heilbronn, 12 tons;
Heilbronn to Hall, 18 tons;
Hall to Nuremberg, 20 tons.
Maximum gradient: Grötzingen to Bretten, 1 in 83 (minimum radius of curves, 450 m.);
Bretten to Nuremberg, 1 in 100 (minimum radius of curves, 290 m.).
Traction: Steam.
Maximum distance between stations: Dombühl to Büchelberg, 9·5 km. (5·9 miles).
Marshalling yards: Heilbronn, Nuremberg.
Locomotive sheds: Heilbronn, Crailsheim, Ansbach, Nuremberg.
Mileage datum: Grötzingen.

This line comprises the greater part of a useful link from the Rhineland to Czechoslovakia and the Dresden area. The daily capacity of the single line section is 20 trains each way and of the doubled section 60 trains.

Leaving the Karlsruhe—Pforzheim line at Grötzingen, this line follows a difficult route, needing a tunnel about 650 ft. long, to Bretten (17·1 km.—10·5 miles). From Bretten to Gemmingen (44·6 km.—27·6 miles) the line keeps at the foot of one of the Neckar scarps and then, utilising the Lein valley, cuts across to Heilbronn (62·1 km.—38·5 miles). Crossing the Neckar and tunnelling for about 3,200 ft. to the Sulm valley, the railway curves north round the northern edge of the Löwensteiner and Waldenburg mountains, requiring a 1,600-ft. tunnel at Gailenkirchen (109·5 km.—68 miles), to the Kocher valley at Schwäb Hall (116·5 km.—72·3 miles). Finding a path (although it means rising nearly 650 ft.) along the northern slopes of the Limpurger and Ellwanger mountains, the railway crosses the Jagst valley at Crailsheim (150·2 km.—93·3 miles). From Crailsheim at 1,342 ft. altitude the railway climbs 207 ft. up to Dombühl (173·5 km.—107·7 miles) in the Franken Höhe, and then by a switchback path over minor watersheds and valleys reaches the junction of Ansbach (196·9 km.—122·2 miles). Turning north-east and running along the waterparting, here about 1,380 ft. high, the line drops gently down, and, crossing the Rednitz by a bridge about 330 ft. long, enters Nuremberg.

(40) *Heilbronn—Osterburken—Lauda—Würzburg*

Length: 127·4 km. (79 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 66 (minimum radius of curves, 312 m.).
Traction: Steam.
Maximum distance between stations: Eubigheim to Uiffingen, 7·1 km. (4·4 miles).
Marshalling yards: Heilbronn, Würzburg.
Locomotive sheds: Heilbronn, Lauda, Würzburg.
Mileage datum: Heilbronn Hbf.

From Heilbronn, on the east bank of the Neckar, the railway runs north on a terrace and after crossing a tributary, the Kocher, turns north-east and follows the intricate meanders of the Jagst to Mockmühl (33·3 km.—22·3 miles). Taking advantage of the Sockach valley it turns north, and crossing a watershed descends by the Umpfer valley to Königshofen (81·7 km.—50·7 miles), and using the Tauber valley for 2·4 km. (1·5 miles) to Lauda makes yet another right-angle turn, this time to ascend the Wittig valley. It then drops down to the Main valley at Heidingsfeld (121·7 km.—75·5 miles). Würzburg is reached by a bridge about 330 ft. long over the Main river.

(41) *Karlsruhe—Stuttgart—Ulm—Munich*

Length: Karlsruhe to Stuttgart, 90·1 km. (56 miles);
Stuttgart to Munich, 240·3 km. (149·3 miles).
Track: Karlsruhe to Ludwigsburg, double;
Ludwigsburg to Stuttgart, 6-track;
Stuttgart to Esslingen, multiple;
Esslingen to Lochhausen, double;
Lochhausen to Munich, 8-track.
Maximum permissible axle-load: 20 tons.
Maximum gradient: Karlsruhe to Stuttgart, 1 in 79 (minimum radius of curves, 210 m.);
Stuttgart to Munich, 1 in 43 (minimum radius of curves, 280 m.).
Traction: Karlsruhe to Stuttgart, steam. Some tracks electrified Ludwigsburg to Stuttgart. Electrified Stuttgart to Munich.
Maximum distance between stations: Westerstetten to Beimerstetten, 6·3 km. (3·9 miles).
Marshalling yards: Karlsruhe, Kornwestheim, Stuttgart, Neu Ulm, Augsburg, Munich (2).
Locomotive sheds. Karlsruhe, Pforzheim, Mühlacker, Kornwestheim, Stuttgart, Plöchingen, Geislingen, Neu Ulm, Augsburg, Munich.
Mileage datum: Karlsruhe Hbf.

This valuable cross-line from the Rhine plain to south Bavaria has a high capacity: from Karlsruhe to Stuttgart 60 trains daily can be accommodated, and east of Stuttgart 72 trains each way.

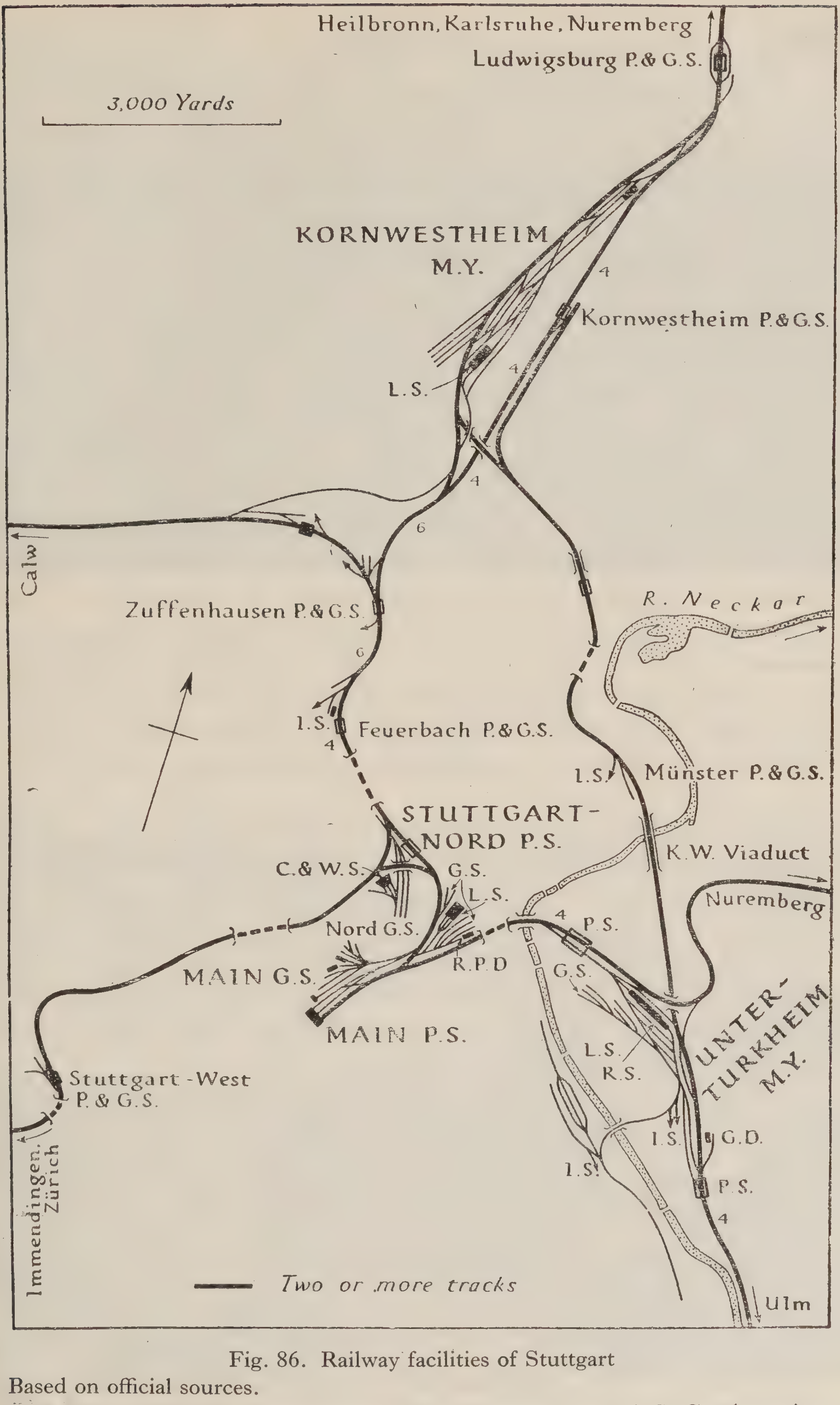


Fig. 86. Railway facilities of Stuttgart

Based on official sources.

C. & W.S. Carriage and wagon shops; G.D. Goods depot; G.S. Goods station; I.S. Industrial sidings; K.W. König Wilhelm; L.S. Loco shed; M.Y. Marshalling yard; P. & G.S. Passenger and goods station; R.P.D. Railway postal depot; R.S. Loco depot and repair shops. The figures indicate the number of tracks where there are more than two. The depth of the valley in this plateau region necessitates three tunnels for the approaches to the stations in the city. Unterturkheim is the chief industrial suburb; the Daimler-Benz works are situated here.

From Karlsruhe the line crosses the plain to Durlach and runs up a small valley across the northern tip of the Black Forest, with a tunnel about 2,600 ft. long at the watershed, to Pforzheim (30·9 km.—19·1 miles). Here, getting into a more deeply trenched terrain, the line turns north-east and follows the Enz, a tributary of the Neckar to Mühlacker (43·5 km.—27 miles) and then is able to cut away from the now greatly meandering stream to Bietigheim (62·7 km.—38·9 miles). Swinging to the south through hilly country, the line reaches the eastern suburbs of Stuttgart (90·1 km.—56 miles). Using the Upper Neckar valley to the uttermost headstream for 60 km. (37·3 miles) beyond Stuttgart, the line reaches Geislingen (150·7 km.—93·6 miles). In the next 6 km. (3·7 miles) occurs the so-called 'Geislingen Steige' where seven banks of a gradient up to 1 in 45 against southbound trains are necessary in order to cross the Swabian Jura.* Dropping down to Ulm (183·4 km.—113·9 miles) the railway crosses the Danube by a bridge about 490 ft. long to Neu Ulm. Running on the south bank of the Danube, dropping only 65 ft. in 21 km. (13·0 miles) the line turns up the Mindel valley at Offingen (216·3 km.—134·3 miles), climbs steadily up 108 ft. to Jettingen (227·0 km.—141 miles), to drop into the Zusam valley (1,515 ft. altitude) over a minor watershed to Gessertshausen (252·9 km.—157·1 miles) at a height of 1,565 ft. Using the Schmutter valley for a few kilometres, it enters Augsburg (268·0 km.—166·4 miles). From Augsburg the line crosses the Lech and its broad floodplain to Mering (283·8 km.—176·2 miles) and then rises to a summit of 1,778 ft. at Haspelmoor (293·2 km.—182·2 miles). Dropping down at 88·6 ft. in 12·4 km. (7·6 miles) to Maisach (305·6 km.—189·8 miles) the line then crosses the southern end of Dachauer Moor, and after being joined by several lines at Pasing (323·0 km.—200·6 miles), enters Munich.

(42) *Munich—Salzburg* (*Austria*)

Length: (*a*) Munich—Rosenheim, 65·0 km. (40·4 miles);
(*b*) Rosenheim—Salzburg, 88·4 km. (54·7 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 81 (minimum radius at curves, 250 m.).
Traction: Electric, 15,000 v. A.C., 16 2/3 cycles single phase.

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* A few miles to the south-west the Stuttgart-Ulm autobahn crosses this escarpment by steep gradients over what is known as the 'Drachensteiner Hang' (Plate 76).

Plate 53. Bingerbrück and Bingen, looking east (up the Rhine)

Along the bank runs the double-track line from Köln to Mainz (left bank); it is seen here crossing the river Nahe to Bingen. On the right the double-track line branching southwards to Bad Kreuznach can be seen. In the middle distance is the Hindenburg bridge, crossing the Rhine at Rüdesheim and connecting the railways on either bank. In the distance is the flat plain where the higher ground lies away from the river between Rüdesheim and Mainz.

Plate 54. Müngstener bridge

This railway bridge is the highest in Germany (see p. 225), and crosses the deep valley of the Wupper in the Bergisches Land.

Plate 55. Wuppertal: the overhead railway

Plate 56. Railways and industry at Dortmund

Maximum distance between stations:
(*a*) Gross Karlolinenfeld to Ostermünchen, 7·4 km. (4·6 miles);
(*b*) Teisendorf to Niederstrass, 8·2 km. (5·1 miles).
Marshalling yards: Munich (3), Rosenheim (Kolbermoor), Freilassing, Salzburg.
Locomotive sheds: Munich, Rosenheim, Freilassing, Salzburg.
Mileage datum: Munich Hbf.

This line is very valuable to Germany as it connects with the railway to Italy, east of the Brenner. The capacity of the line to Rosenheim is about 72 trains per day with electric traction and 48 with steam: beyond Rosenheim the capacity is reduced to 48 and 36 respectively.

From Munich the line proceeds across the high open country at about 1,600 ft. altitude to Eglharting (30·5 km.—18·9 miles), where it enters a more broken terrain. Curving to the south-east to take advantage of a headwater of the Attel river, it reaches the railway junction town of Rosenheim. Crossing, first, a canalized stream, and then the Inn, the railway runs by the side of the Sims river and lake to Endorf (81·7 km.—50·8 miles), and then swings south to avoid Chien lake and the wettest part of the Filz marshes, which lie to the south of the lake. Running through the marshland, the railway reaches Traunstein (118·3 km.—73·5 miles), and then uses the Sur valley to avoid passing through the high ground of the Teisen mountains. From the frontier post of Freilassing (146·7 km.—91·1 miles) the Reichsbahn has its own metals to Salzburg on the Salzach river.

(43) *Munich—Innsbruck* (*Austria*)

Length: 158·0 km. (98 miles).
Track: Munich Hbf. to Tutzing (39·6 km.—24·6 miles), double;
Tutzing to Innsbruck, single.
Maximum permissible axle-load: Munich to Scharnitz (former frontier), 20 tons;
Scharnitz to Innsbruck Hbf., 14 tons.
Maximum gradient: Munich to frontier, 1 in 60 (and minimum radius of curves, 200 m.).
Traction: Electric, 15,000 v. A.C. 16 2/3 cycles, single phase.
Maximum distance between stations: Huglfing to Uffing, 7·2 km. (4·5 miles).
Marshalling yards: Munich, Innsbruck.
Locomotive sheds: Munich, Innsbruck.
Mileage datum: Munich Hbf.

The capacity of this line is low on account of steep gradients, sharp curves and single track; with electric traction up to 16 trains and with steam up to 12 trains can be accommodated daily each way. In addition, the net load is limited to 300 tons.

Leaving Munich, which is about 1,640 ft. above sea-level, by the 8-track route to the west and crossing directly over the Würm river,

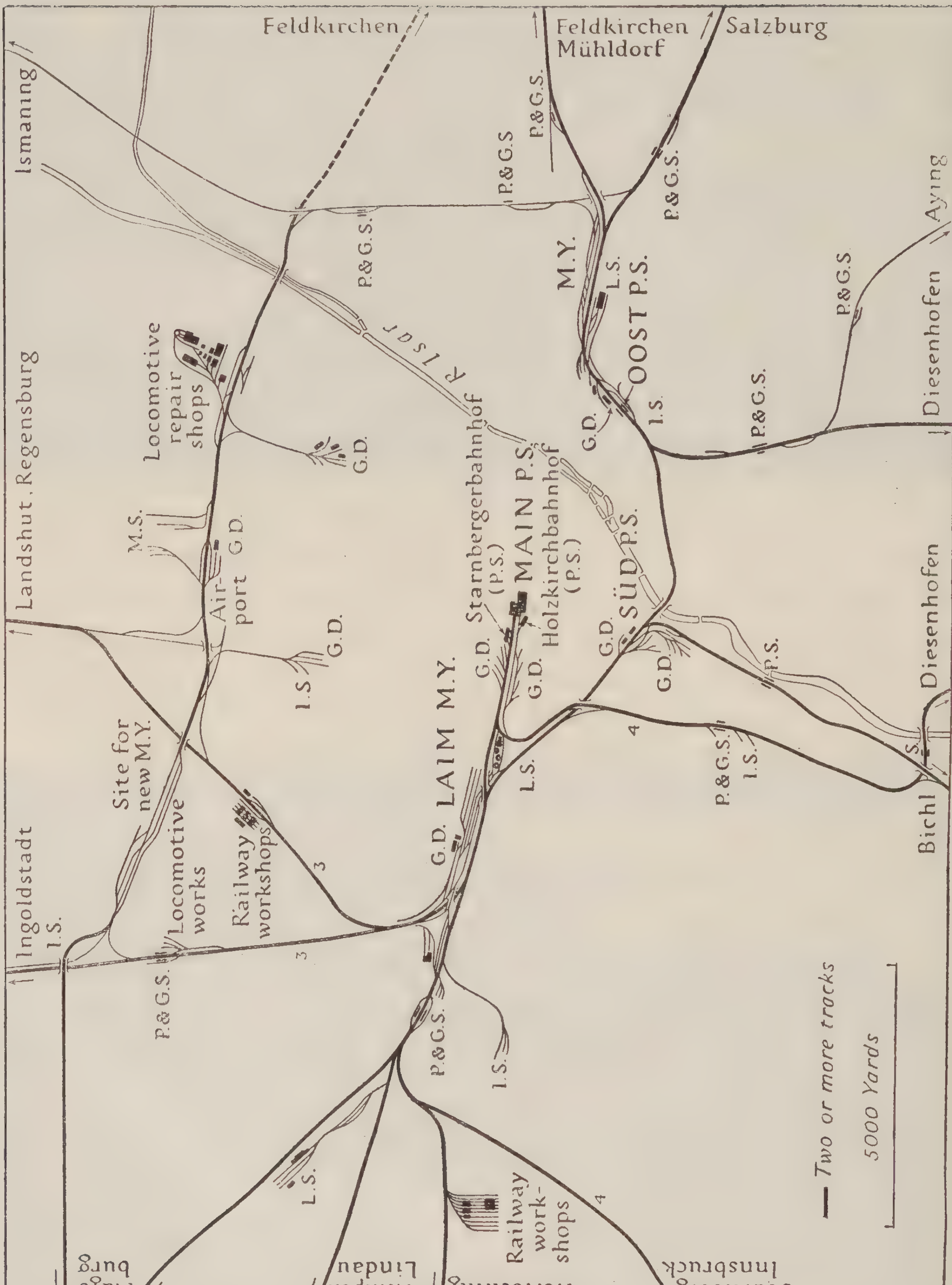

Fig. 87. Railway facilities of Munich

Based on official sources.

G.D. Goods depot; I.S. Industrial sidings; L.S. Loco shed; M.S. Military sidings; M.Y. Marshalling yard; P. & G.S. Passenger and goods station; P.S. Passenger station. The figures indicate the number of tracks where there are more than two.

the line then turns south and runs first along the bank of the river, then by the side of the Würm See (altitude 1,919 ft.), as far south as Tutzing (altitude about 1,970 ft.). The line then turns west through Diemendorf (43·6 km.—27 miles) and enters the valley of the Ammer. Between Polling and Huglfing it deserts the main valley for a tributary and climbs to the Loisach river at Hechendorf (77·9 km.—48·4 miles). Skirting for some 10 km. (6·2 miles) along the eastern edge of the Ramsach marshes, the line rises to the tourist centre of Garmisch-Partenkirchen (100·6 km.—62·4 miles), where rack and pinion and cable railways run to the Zugspitze (see p. 273). Swinging to the east by the Kanker valley, the line enters the upper Isar valley and so works a way between the Wetterstein and Karwendel mountains which form the frontier with Austria. Rising sharply from a height of 3,280 ft. at Scharnitz (124·3 km.—77·2 miles), still in the Isar valley, to Seefeld at a height of 4,260 ft. (134·3 km.—83·4 miles), the line reaches the Inn valley and descends to Innsbruck, which is about 1,300 ft. above sea-level, by steep down gradients and tunnels, of which the longest is Martinswand (about 1·5 miles long). The mountainous section of this railway is followed closely by the main road. The working of this line is further limited from Innsbruck to Scharnitz by the reduction of the loading gauge to 4·5 m. for easily inflammable goods such as hay, straw and flax, while long objects loaded on two or more wagons cannot be carried. These limitations are imposed by the depression of the overhead electric wires in the tunnels and by the sharp curves, respectively. Handbrakes are desirable on all rolling stock on account of the sharp gradients.

(44) *Nuremberg—Augsburg—Kempten—Lindau*

Length: Nuremberg to Treuchtlingen, 61·8 km. (38·4 miles);
Treuchtlingen to Augsburg, 75·3 km. (48·4 miles);
Augsburg to Lindau, 191·8 km. (119·2 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: Treuchtlingen to Augsburg, 1 in 110.
Augsburg to Buckloe, 1 in 120 (minimum radius of curves, 510 m.);
Buckloe to Lindau, 1 in 80 (minimum radius of curves, 292 m.).
Traction: Nuremberg to Augsburg, electric;
Augsburg to Lindau, steam.
Maximum distance between stations: Mündling to Donauwörth, 11·4 km. (7 miles);
Günzach to Wildpoldsried, 9·9 km. (6·1 miles).
Marshalling yard: Nuremberg, Augsburg, Kempten (minor yard), Lindau (minor yard).
Locomotive sheds: Nuremberg, Treuchtlingen, Augsburg, Kempten, Lindau.
Mileage datum: Nuremberg Hbf.

With gentle gradients and curves, as easy as any in Germany, the northern sections can handle a great weight of traffic. The daily capacity of the line is 60 trains each way on the section Nuremberg to Treuchtlingen and 72 trains Treuchtlingen to Augsburg, but drops to 48 trains on the section Augsburg to Lindau. This route forms part of the main line between central Germany and Zürich in Switzerland.

From Nuremberg Hbf. the rail runs through the south-western suburbs to the Rednitz valley. Crossing this river near Reichelsdorf (8·4 km.—5·2 miles), it runs close to the west bank to Pleinfeld (43·7 km.—27·1 miles). It then runs down a tributary valley of the Altmühl and crosses the main valley at Treuchtlingen (61·8 km.—38·4 miles) which lies 1,378 ft. above sea-level. Climbing the Möhren valley to Gundelsheim (70·4 km.—43·7 miles), the line crosses the Franconian Jura and drops to Donauwörth (96·4 km.—59·9 miles) on the Danube at 1,325 ft. altitude. The railway now runs in the flat valley between the Schmutter and Lech, right-hand tributaries of the Danube, to Augsburg Hbf. (137·1 km.—85·2 miles), ascending some 280 ft. The steepest gradient on this section is found between Augsburg-Oberhausen and Hauptbahnhof stations where the line rises 49 ft. to 1,604 ft. altitude in 2·2 km. (i.e. 1 in 110).

From Augsburg to Lindau the line suffers from many steep gradients and sharp curves, particularly south of Günzach. Leaving Augsburg, the route crosses Lechfeld between the Wertach and Lech rivers to Buckloe (175·0 km.—108·7 miles), and crossing the Gennach tributary ascends to Kaufbeuren (196·2 km.—121·9 miles), where it crosses the Wertach. Using a tributary valley to give height, the railway traverses the head valleys of the Iller drainage basin, passing over the main river at Kempten (237·8 km.—147·7 miles). At Kempten the track turns south and follows on the west bank this deeply cut section of the meandering river to Oberdorf (250·3 km.—155·5 miles), where it again makes a right-angle turn and takes an intricate route on the north flank of the Allgaüer Alps to Lindau on an island in Lake Constance. The railway crosses to the island by a causeway about 1,800 ft. long. At the town steamships plying on Lake Constance (Bodensee) make connexions with the trains, and serve Romanshorn on the Swiss shore.

(45) *Kempten (Allgau)—Neu Ulm*

Length: 85·0 km. (52·8 miles).
Track: Single.
Maximum permissible axle-load: Kempten to Memmingen, 20 tons;
Memmingen to Neu Ulm 18 tons.

Maximum gradient: 1 in 140.
Traction: Steam.
Maximum distance between stations: Kempten to Heising, 8·9 km. (5·5 miles).
Marshalling yards: Kempten (minor yard), Memmingen (minor yard), Ulm.
Locomotive sheds: Kempten, Memmingen, Neu Ulm.
Mileage datum: Kempten (Allgau).

This route forms part of the main line from Lindau and Switzerland to Frankfurt-am-Main (via Karlsruhe, Heidelberg and Mannheim) and to central Germany. Being single track the daily capacity of the line is low with 12 to 16 trains each way. Leaving Kempten, the line crosses the Iller river by a 500-ft. concrete bridge and then turns to the east of this river. It crosses right-hand tributaries and the adjoining marshes of the Iller as far as a point just south of Memmingen (34·9 km.—21·6 miles) where, having reached its summit height of about 2,000 ft., it descends on the right bank of the Günz. This river runs in the same floodplain as the Iller for about 40 km. to Senden, and the line keeps for the most part just off the floodplain. At Neu Ulm the railway joins the electrified line from Ulm to Munich.

(46) *Treuchtlingen—Ingolstadt—Munich*

Length: 136·8 km. (84·9 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 40 (minimum radius of curves, 292 m.).
Traction: Steam.
Maximum distance between stations: Solnhofen to Dollnstein, 7·2 km. (4·5 miles).
Marshalling yards: Munich (2).
Locomotive sheds: Treuchtlingen, Ingolstadt, Munich.
Mileage datum: Treuchtlingen.

This line provides a valuable alternative to that via Donauwörth (Route No. 44, described above). The maximum number of trains per day which can be handled is 60 each way.

Treuchtlingen is at an altitude of 1,407 ft. and the line drops to 1,345 ft. in crossing the Altmühl river at Pappenheim (6·4 km.—3·9 miles). The railway follows this river valley, closely cutting across meanders. There are 9 bridges over the river between Treuchtlingen and Dollnstein (18·8 km.—11·6 miles), and the line is still below the height it was at Treuchtlingen. Beyond Obereichstätt (21·7 km.—13·4 miles) it begins to climb and reaches a local summit, in its crossing of the Franconian Jura, at Adelshlag 33·9 km. (21 miles) with an altitude of 1,450 ft. From here it drops into the Danube valley, which it crosses by a bridge about 740 ft. long with

a river gap about 300 ft. wide. Immediately after crossing the Danube it enters the railway junction of Ingolstadt (55·2 km.—34·2 miles) at an altitude of 1,206 ft. Leaving Ingolstadt, the line runs to Reichertshofen (64·4 km.—39·9 miles) and then crosses the river Paar and rises about 150 ft. before dropping sharply into the Ilm valley. Running on the west bank of the Ilm to Reichertshausen (93·0 km.—57·7 miles) the railway, rising slightly, crosses the Glon river to Dachau (119·0 km.—73·8 miles), at 1,581 ft. Crossing the Amper river the railway runs across Dachauer Moor to Munich.

(47) *Tuttlingen—Ulm*

Length: 135·0 km. (83·7 miles).
Track: Tuttlingen to Ulm-Soflingen single, thence double.
Maximum permissible axle-load: Tuttlingen to Mengen, 16 tons;
Mengen to Schelklingen, 20 tons;
Schelklingen to Ulm-Soflingen, 18 tons;
Ulm-Soflingen to Ulm Hbf., 20 tons.
Maximum gradient: 1 in 143 (minimum radius of curves, 286 m.).
Traction: Steam.
Maximum distance between stations: Gerhausen to Herrlingen, 7·8 km. (4·8 miles).
Marshalling yard: Ulm.
Locomotive sheds: Ulm.
Mileage datum: Tuttlingen.

This line provides an important cross-country service from south-west Baden to the main west-east line at Ulm. The daily capacity of the line is only 12 trains each way and the net load is restricted to 350 tons.

Running north-east from Tuttlingen, generally on the north bank of the deeply incised Danube, but occasionally cutting off large meanders where it is difficult for the railway to pass without bridging owing to cliffs, the railway is only able to break away from the river where it leaves the Swabian Jura near Sigmaringen (42·2 km.—26·2 miles). The only tunnel is near Fridingen (150 km.—93·2 miles) and is about 2,300 ft. long. From here it keeps well south of the river where there is a broad floodplain partly built up by the incoming Schwarzach. Between Unlingen (73·3 km.—45·4 miles) and Rottenacker (94·3 km.—58·6 miles) the railway is forced by broken uplands again to follow meanders of the Danube. At Ehingen (101·4 km.—62·9 miles) it takes advantage, even at the cost of rising up to Schelklingen (112·3 km.—69·7 miles), of a left-hand tributary, the Schmiech, to escape north, and enters Ulm from the north-west by the Ach and Blau valleys on the north side of the Hochsträss upland.

Central Germany

Extending from Hanover to Berlin and from Würzburg to the Czechoslovakian frontier, this region covers the intensive network of railways serving the industrial areas of Saxony and Thuringia and connecting such important centres as Zwickau, Leipzig, Halle, Dessau, Merseburg, Magdeburg, Brunswick and Hanover with each other and with Berlin. Apart from providing routes for the heavy short-distance traffic, these lines provide connexions from Berlin and Bavaria to the Middle Rhineland, and from the North Sea ports to Saxony and Czechoslovakia.

The density of the network varies greatly, being closest in the industrial area and sparsest in the country to the north-east and south-west. Across the Czechoslovakian border there are a number of trans-frontier lines (mostly *Nebenbahnen*) which converge upon Prague.

Physical Background

This region is one of considerable complexity in its relief. The western half includes the middle and upper valley of the Weser (see p. 311). The northern zone, along the junction of the North German Plain and the central and southern uplands, comprises the fertile, industrially valuable 'Börderland'. The southern part of the region consists mainly of the uplands, diversified by the lowland 'bays' of Leipzig and Thuringia.

The 'Börderland' of Hanover—Magdeburg extends from the Weser to the Elbe and the fertile loess soils make it one of the richest agricultural areas of Germany, especially suitable for sugar-beet and cereals. Along this belt railway construction has been easy. The middle Elbe lowlands consist mainly of the broad floodplain of the river; here the railways avoid the lowest ground and keep to the bounding bluffs. East of this lowland is the sparsely-peopled Fläming area, a continuation of the sandy *geest* of the Lüneburg heath. The Fläming is easily crossed by railways radiating south-west from Berlin to the central industrial belt. The Saxony—Thuringian 'Bay' is diversified by low ridges and hills. In the south, where loess deposits occur, the rich agricultural belt has long been a highway and is the location of important railways and junctions, chief of which are Leipzig and Halle. In this belt are thick deposits of lignite and potash salts which together swell the railway traffic, while the former has facilitated railway electrification by providing a cheap fuel for power stations.

To the south-east is the Saxony coalfield at the base of the Erz Gebirge, with its chief centres at Zwickau and Chemnitz. The railways serving this coalfield offer difficult gradients as they penetrate

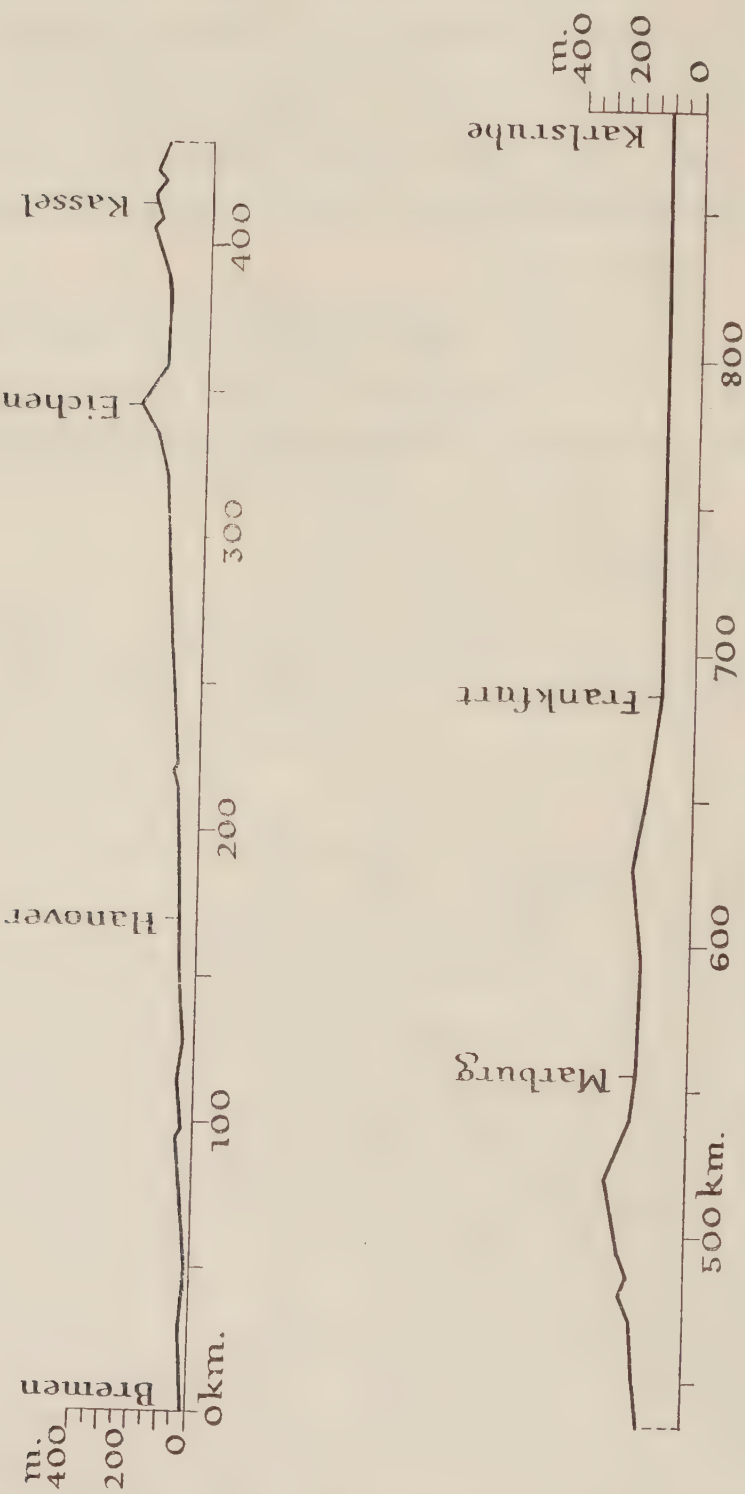

Fig. 88. Gradient profile, Bremen—Kassel—Karlsruhe

Based on Blum, —, 'Trassierungs-Grundsätze für Eisenbahnen ausserhalb der hochindustrialisierten Gebiete, *Verkehrstechnische Woche*, 27th year, Heft 38, pp. 552–60 (Berlin 1933).

Vertical exaggeration approximately 100 times.

into the high altitudes of the Erz Gebirge. The development of nonferrous metals and of health resorts has encouraged the growth of branch railways into the mountains; some of these single-track lines

Fig. 89. The railways of central Germany

Based on G.S.G.S. Series 4072, Europe (Air), 1 : 500,000, Sheets N.E. 52/6, N.E. 52/10, N.E. 50/6, N.E. 50/10, N.E. 48/6, N.E. 48/10 (1940–2), and other official sources.

For key to symbols see Fig. 68.

continue southwards into Czechoslovakia. Westwards of the Erz Gebirge is the broken hill country of the Vogtland. This small district, however, is easy of access, and is crossed by several railways which have their chief centre at Plauen. The main line from Zwickau to south Germany crosses the Vogtland.

East of the Erz Gebirge lies a sandstone terrain, much eroded by rivers, dominated by the Elbe gorge, which is cut to a depth of 600 ft., often between sheer cliffs. This great natural corridor is followed by the main railway from Dresden into Czechoslovakia.

Railway Divisions

This region includes the R.B.D.s of Erfurt and Halle, together with considerable portions of the operating divisions of Nuremberg, Kassel, Hanover, Berlin and Dresden, and a small portion of the Regensburg division.

The north-eastern part of the R.B.D. of Nuremberg includes main lines following the upper course of the Main valley through the Main Scarplands and connecting with the R.B.D.s of Regensburg and Erfurt. Regensburg R.B.D. covers the lines in the difficult country of the Fichtel Gebirge. The R.B.D. of Erfurt is set in the Thuringian Basin, being separated from lower land to the south-west by the Thuringian and Franconian Forests and to the north by the Harz mountains. Here it meets the southern extention of Hanover R.B.D. in the 'Börderland' of Hanover—Magdeburg. Halle R.B.D. occupies the Saxony—Thuringian 'Bay' which lies at a much lower altitude than the adjoining Thuringian Basin. Finally, the western half of Dresden R.B.D. extends from the Erz Gebirge to the Vogtland area. In the lower lands of this region it might be expected that railways could follow freely the shortest routes, but they are, in fact, restricted owing to the incision of the valleys, and the main routes tend to follow rivers, e.g. the double track from Leipzig to Weimar over part of its length follows the river Saale. The industrial activities in the area, besides leading to a close network, have necessitated many large junction points of which Leipzig and Hanover are the most important.

Engineering Structures

The Elbe flows through eastern part of the region and long bridges are found where the main routes cross this river. Considerable bridges are also necessary in the deeply-cut valleys of headwater

streams in the Erz Gebirge, used by both main and secondary lines reaching towards Czechoslovakia.

Principal Bridges

No. on map	Bridge	Over	Date built	Total length, ft.	No. of tracks	Construction
115	Biederitz	R. Elbe	1925	1,509	2	Steel spans
114	Magdeburg	R. Elbe	1907	2,215	2	,, ,,
111	Potsdam	R. Havel	1925–26	298	2	,, ,,
112	Wittenberg	R. Elbe	1924	302	2	,, ,,
113	Mansfeld	Hasselbachtal	1915	741	1	Steel girders
113*a*	Bernburg	R. Saale	1927	1,257	4	Steel spans
77	Bockwallendorf	Valley	1912–13	797	?	Concrete arches
80	Jocketa	Elstertal	1846–51	915	2	Granite arches
81	Reichenbach im Vogtland	Göltzschtal	1846–51	1,870	2	Brick and granite arches
81	Weida	Oschutztal	1884	558	1	Steel spans
83	Mittweide-Markersbach	Valley	1888	787	1	Steel girders
84	Grünhain	Gockeritztal	1899–1900	804	1	Steel spans
84*a*	Geyer	Greifenbachtal	1905	590	1	Steel girders
85	Limbach	Auritzbachtal	1897	459	1	Steel spans
86	Oberrabenstein	Rabensteinertal	1898	328	1	,, ,,
87	Göhren	Muldental	1870–71	1,394	?	Sandstone arches
88	Waldheim	Dieten-Mühlental	1846–52	689	1	Brick arches
89*a*	Döbeln	R. Mulde	1927	270	1	Steel spans
89	Waldheim	Heiligenborntal	1852	692	2	Sandstone arches
90	Waldheim	Heiligenborntal	1896	541	1	Steel spans
91	Riesa	R. Elbe	1877–8	1,148	2	,, ,,
92	Meissen	R. Elbe	1925–6	853	2	,, ,,

From official sources.

The location of these bridges is shown in Fig. 51.

Railway Operating Features

Outside the industrial area from Saxony to Hanover large marshalling yards are only found at Würzburg, Kassel, Gerstungen and Erfurt to the south-west and at Stendal (near Berlin) to the north-west. By contrast there are in the industrial area eighteen large yards, located at Hanover, Brunswick, Halberstadt, Magdeburg, Rosslau, Bitterfeld, Merseburg, Weissenfels (at the terminus of the electric line from the south), Leipzig, Zeitz, Gera, Chemnitz and Dresden. Railway repair shops are situated at Brunswick (locomotives);

Magdeburg (rolling stock); Stendal (locomotives); Gotha (rolling stock); Jena (goods wagons); Chemnitz (locomotives and rolling stock); Dresden (rolling stock); Zwickau (locomotives and rolling stock); Delitsch (locomotives and rolling stock); Dessau (electric locomotives and railcars); Halle (locomotives); Leipzig (locomotives and rolling stock); Meiningen (locomotives); Paderborn (locomotives and rolling stock); Göttingen (locomotives); Kassel (rolling stock).

Traffic

Passenger Traffic. The long-distance passenger traffic of this region follows two main trends: an arc from north-west to south-east and an arc from north to south-west. The intersection of the lines gives rise to many junctions and opportunities for D-train operation. Short-distance passenger circulation is marked by special features.

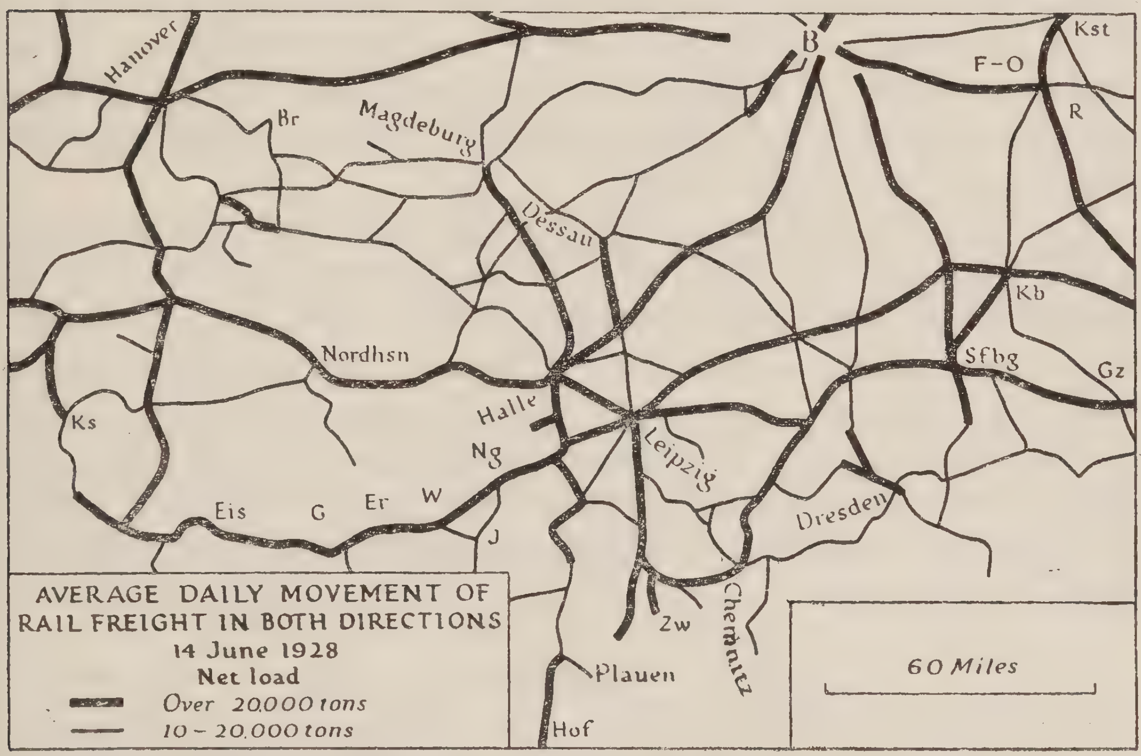

Fig. 90. Average daily movement of goods trains in central Germany

Based on a plate in the *Merseburg Atlas.*

The lignite production and chemical industries of this region result in a heavy movement of freight, both internally and to other parts of Germany. The short-distance but heavy traffic west of Merseburg arises from the transport of lignite from the workings to the Leunawerke. In the coalfield of Saxony there is a smaller traffic, for its industries are mainly concerned with highly fabricated products. Heavy traffic originates from the lignite workings of Brandenburg, to the south of Kottbus. B Berlin; Br Brunswick; Eis Eisenach; Er Erfurt; F-O Frankfurt-an-der-Oder; G Gotha; Gz Görlitz; J Jena; Kb Kottbus; Ks Kassel; Kst Küstrin; Ng Naumburg; R Reppen; Sfbg Senftenberg; W Weimar; Zw Zwickau.

A survey of the daily movement of the working population made in 1929 showed that there were big movements from Leipzig, Magdeburg and Halle to the great lignite workings and to the big chemical works of which *Ammoniakwerk Merseburg* (Leuna) is outstanding. Leuna, with a pay-roll of 22,000, has few people living near it; at least two-fifths of the workpeople travel at least an hour each way daily. The Leuna Works draws labour from the Mansfeld district, over 30 miles away, for the decline of copper mining there freed many workmen. It is said that the policy of employing workmen who lived at a distance was adopted in order to reduce the likelihood of strikes by removing opportunity for mass gatherings in free time.

Goods Traffic. This great chemical centre of Germany produces commodities in demand throughout the Reich, and in the absence of good waterways, the railways carry a large share of the output. The principal freight line is that running west from Halle to the Ruhr, while a second important line runs through Erfurt to Bebra, where it connects with the line from Hanover to Frankfurt-am-Main. Other important lines run southwards through Werdau, and eastwards through Leipzig and Falkenberg to Silesia. Traffic with the Berlin area is relatively limited.

The six traffic districts of Hanover and Hildesheim; Magdeburg, Anhalt; Merseburg and Erfurt; Thuringia; Saxony; and Leipzig approximately cover the region except that the Hanover and Magdeburg districts extend into north Germany and the Hesse-Nassau and Westphalian Ruhr districts extend into the west of the region.

The great tonnage unloaded and loaded as well as the huge local traffic reflects the industrial activity. Unloadings and loadings within the region approximately balance and so there are relatively few long hauls of empty stock.

Traffic, 1936 (*in thousands of tons*)

District	Local	Loaded to	Unloaded from	Loaded to	Unloaded from
		other German districts		foreign countries	
Hanover and Hildesheim	5,678	9,188	8,487	43	42
Magdeburg, Anhalt	6,127	6,308	9,371	62	32
Merseburg and Erfurt	7,177	17,265	10,108	127	109
Thuringia	3,100	5,569	7,838	60	106
Saxony	9,812	10,145	11,697	145	1,516
Leipzig	477	1,752	3,982	23	73

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1936*, Heft I, II, *passim.*

Fig. 91. Principal traffic-producing points in the central industrial region

Based on official sources.

The larger plants are shown by the larger symbols; they are dependent on the railways to a far greater degree than the smaller plants. The area here called the 'Central industrial region' is one which functions largely as a unit industrially and economically; the boundary shown (by a fine line) is based primarily upon industrial inter-relations, but in part upon the boundaries of provinces, states (*Länder*), districts (*Regierungsbezirke*) and counties (*Kreise*). The railways have been the dominant transport agent: only the north-east of this region was served by the Elbe for water transport: the decade ending in 1939 saw important changes, however, for the Mittelland Canal was connected with the Elbe in 1938 and road transport made enormous strides. The chief improvement in transport in the near future should be the enlargement of the river Saale from Barby to Merseburg and the completion of a canal from Halle to Leipzig. An Aschersleben; BH Bleckenstedt-Hallendorf; Br Brunswick; Eis Eisenach; Er Erfurt; Fn Fallersleben; G Gotha; Hb Halberstadt; J Jena; Kl Kassel; On Oschersleben; Pe Peine; W Weimar; Wg Wittenberg.

A summary of the larger items in the goods traffic of railway traffic district No. 19*a* (Merseburg and Erfurt) illustrates some features of the rail movement in central Germany.

Goods Traffic of the Merseburg and Erfurt district, 1936 *by traffic districts to or from which commodity items of* 50,000 *tons or more were despatched or received (in thousands of tons)*

	Outwards from No. 19*a*	Inwards to No. 19*a*
Pomerania	Lignite briquettes (124·4), potash fertilizer (67·5)	—
Pomeranian ports	Lignite briquettes (110·0)	—
Mecklenburg	Lignite briquettes (81·0), nitrogen fertilizer (62·4)	—
Baltic ports from Rostock to Flensburg	Lignite briquettes (63·8)	—
Schleswig-Holstein	Lignite briquettes (74·2)	—
Elbe ports	Nitrogen fertilizer (98·8)	—
Oldenburg	Lignite briquettes (58·8), potash fertilizer (133·9)	—
Hanover and Hildesheim	Lignite briquettes (244·0), lignite coke (51·7), unspecified chemicals (134·6), potash fertilizer (81·2), nitrogen fertilizer (65·6), artificial stone (81·4)	Worked stone (493·4), limestone (206·5), cement (50·7), unspecified chemicals (67·4)
Upper Silesia	—	Coal (219·1)
Lower Silesia	Potash fertilizer (102·6), nitrogen fertilizer (86·9)	Coal (61·2), coke (142·5)
Berlin	Lignite briquettes (360·4), sand (149·1)	—
Brandenburg	Lignite (120·9), lignite briquettes (315·5), potash fertilizer (85·7), nitrogen fertilizer (147·1)	—
Magdeburg, Anhalt	Sugar beet (94·0), lignite (1,003·6), lignite briquettes (582·1), lignite coke (152·9), sand (93·6), unspecified chemicals (203·2), potash fertilizer (125·4), nitrogen fertilizer (193·0), artificial stone (96·7)	Lignite briquettes (61·0), sand (69·4), cement (115·8), salt (117·8), pulpwood (84·2)
Thuringia	Raw sugar (55·5), lignite (514·8), lignite briquettes (1,167·3), lignite coke (51·2), sand (553·2), other mineral raw materials (56·3)	Sugar beet (135·4), lignite briquettes (80·9), worked stone (217·6), sand (54·3), building timber (65·1)
Saxony	Lignite (270·2), lignite briquettes (1,606·5), sand (234·7), cement (99·3), potash fertilizer (54·4), nitrogen fertilizer (55·6), scrap iron (75·6)	Coke (55·9), lignite briquettes (141·0), worked stone (707·6), sand (150·1)
Leipzig	Lignite (240·0), lignite briquettes (195·5), sand (110·6)	Sand (125·7)
Hesse-Nassau	Lignite briquettes (138·9)	Worked stone (126·7)
Westphalian Ruhr	—	Coal (561·5), coal briquettes (92·1), coke (1,347·2)
Rhine prov. Ruhr	—	Coal (93·5)
Westphalia	Potash fertilizer (108·7)	Cement (96·3)
S. Bavaria	Lignite briquettes (163·8)	
N. Bavaria	Lignite briquettes (493·5)	—

Route descriptions

(48) *Hanover—Magdeburg—Berlin*

Length: 291·2 km. (180·9 miles).
Track: Double to Berlin (Zehlendorf), thence multiple.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in $1\frac{3}{4}$ (minimum radius of curves, 300 m.).
Traction: Steam; electric suburban service Berlin area.
Maximum distance between stations: Kirchmoser to Brandenburg Reichsbahn, 11·8 km. (7·3 miles).
Marshalling yards: Hanover, Lehrte, Brunswick, Magdeburg, Berlin.
Locomotive sheds: Hanover, Lehrte, Brunswick, Helmstedt, Eisleben, Magdeburg, Güsen, Brandenburg, Potsdam, Berlin.
Mileage datum: Hanover Hbf.

This is a trunk route between Hanover and Berlin via the northern part of the central industrial area. At Hanover are concentrated routes from the Ruhr and the Weser ports, while at Magdeburg routes converge from the south-east going towards Hamburg and the north-west generally. The daily capacity of the line is high at 72 trains both ways each with a net load of 600 tons.

From Hanover this route is the same as the direct route from Hanover to Berlin as far as the junction at Lehrte (16·3 km.—10·8 miles). At this important junction, where major south and east-west routes cross, the line for Brunswick takes off to the south-east. Crossing the Fuse river at Peine (17·4 km.—10·7 miles), the railway passes on the south side of Brunswick (62·9 km.—39·1 miles). Leaving the city, which has its main station on a spur, the line passes through broken country on the north side of the Elms upland and, after using the Aller valley for a few kilometres, the railway approaches Magdeburg (149·3 km.—92·8 miles) on the south side, but swings round the western half of the city to cross the Elbe by two parallel single-track girder bridges on common piers. These bridges, 1,509 ft. long, were constructed in 1925. Having crossed the Elbe at right angles, the railway turns to the north-east and, running at the edge of the bluffs above the Elbe floodplain, turns at Genthin

(199·7 km.—114·1 miles) on the north of Fiener Bruck marshes and, curving between the lakes, continues with a modern bridge 298 ft. long over the river Havel through Potsdam (265·2 km.—164·7 miles) into the south-western suburbs of Berlin.

(49) *Nordhausen—Halle*

Length: 97·3 km. (60·4 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Maximum gradient: 1 in 97 (minimum radius of curves, 400 m.).
Traction: Steam.
Maximum distance between Stations: Schlettau to Halle, 9·9 km. (6·1 miles).
Marshalling yard: Halle.
Locomotive sheds: Nordhausen, Sangerhausen, Oberröblingen, Halle.
Mileage datum: Nordhausen.

This line, part of a main route between the Ruhr and central Germany and Berlin, carries the heaviest freight traffic between the two industrial areas.

From the west railways converge from Kassel, by the Wipper valley, and from Northeim and the Ruhr by the Bode valley. At Nordhausen the railway is on the north side of the wide valley of the Heime which is known as the 'Goldene Aue' (Golden Meadows). This rich agricultural district is bounded to the north by the Harz and to the south by the Weindleite and Kyffhäuser ridges and has a value for through, as well as for local, traffic. Leaving Nordhausen, the railway runs to Sangerhausen (37·9 km.—23·5 miles) and there leaves the main valley and runs up the Gonna, a tributary of the Heime, across the waterparting at the south-eastern tip of the Harz to Eisleben (59·5 km.—36·9 miles). Curving south at the foot of steep ground the railway uses the Weida valley, and rising out of this through Zscherben (84·6 km.—52·5 miles), crosses the Saale river two or three kilometres to the south of Halle and approaches Halle from the south-east.

(50) *Berlin—Bitterfeld—Leipzig*

Length: 164·3 km. (102·1 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Traction: Steam, Berlin to Bitterfeld; electric, Bitterfeld to Leipzig.
Maximum distance between stations: Trebbin to Woltersdorf, 11·7 km. (7·2 miles).
Marshalling yards: Berlin, Bitterfeld, Leipzig.
Locomotive sheds: Berlin, Jüterbog, Wittenberg, Bitterfeld, Leipzig.
Mileage datum: Berlin-Anhalter Hbf.

Comprising part of the main route between Berlin and central and

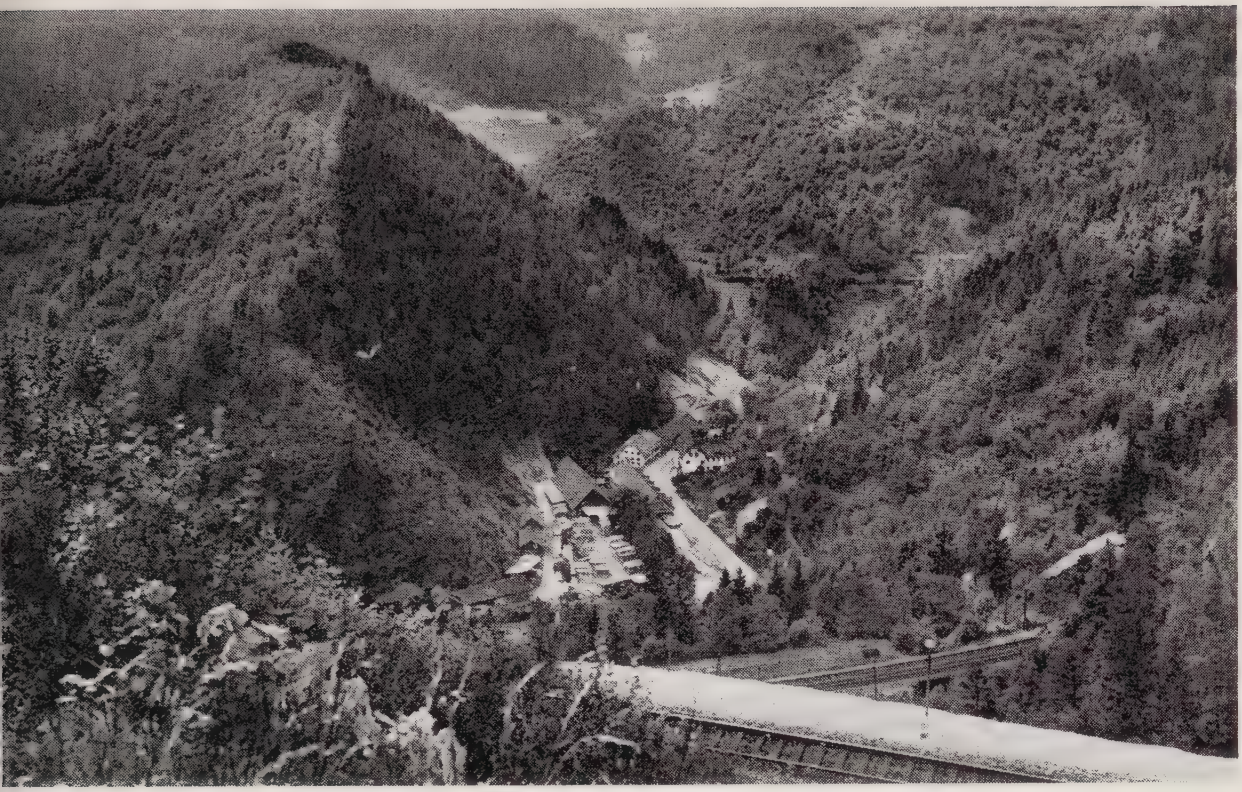

Plate 57. Triberg: the Black Forest Railway

The Black Forest Railway runs from Offenburg to Donaueschingen, crossing the north of the highland from north-west to south-east. Near Triberg, in the valley of the Gutach, two loops and a tunnel are necessary to overcome the gradients. The line can be seen in the foreground, again immediately below, and again running across the end of the valley in the background.

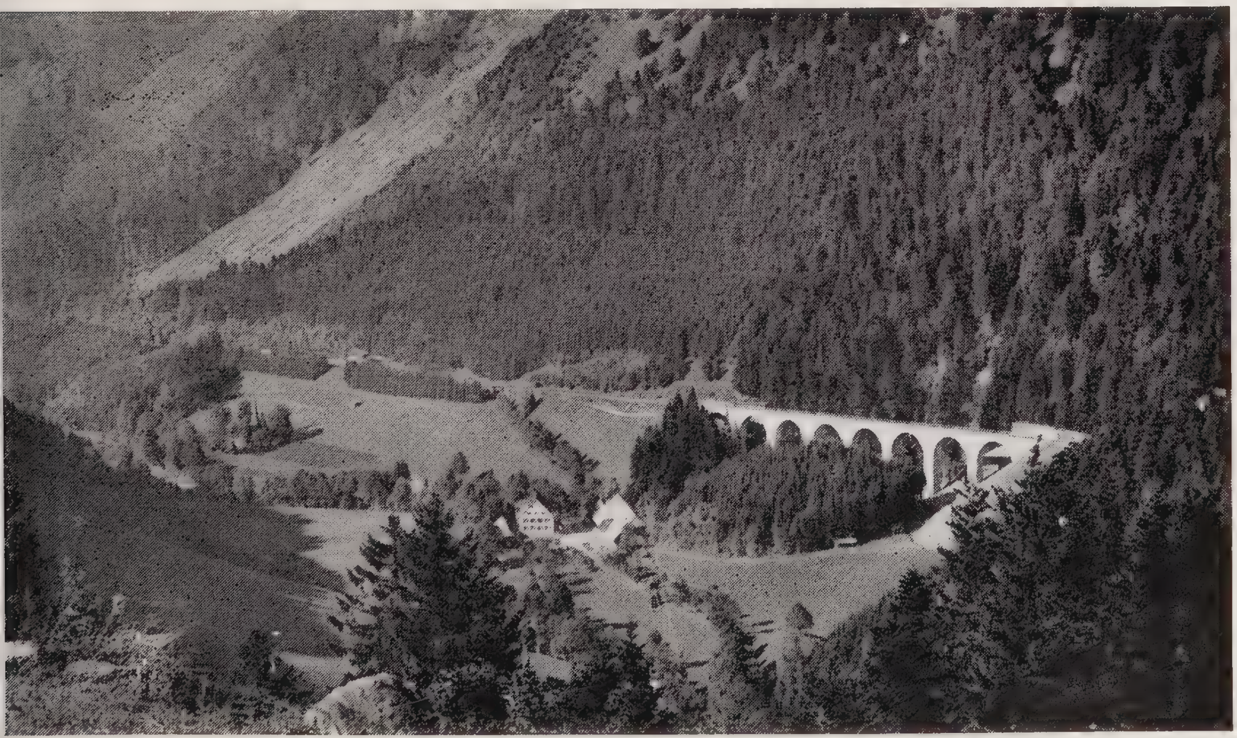

Plate 58. Höllental: the Ravenna viaduct

This structure, on the line from Freiburg to Donaueschingen across the southern part of the Black Forest, bridges a side ravine. It was reconstructed in 1927 (see p. 341); the remains of the earlier bridge can be seen behind.

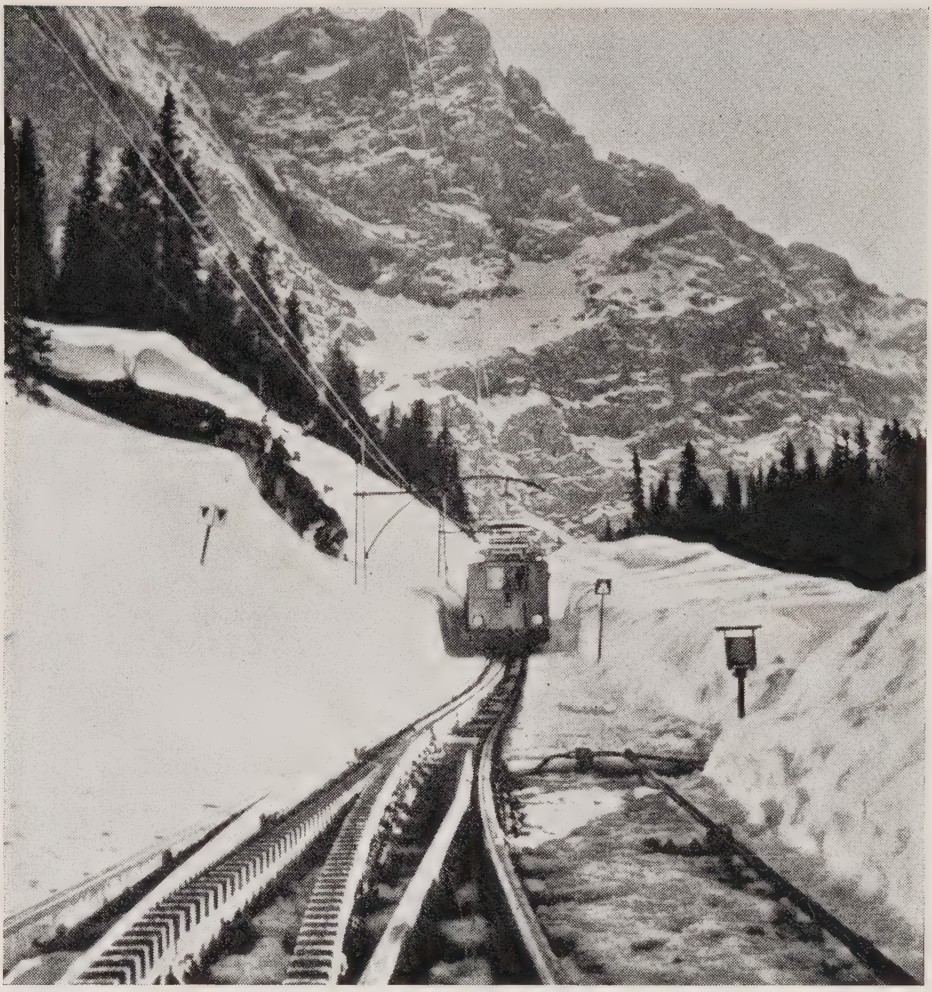

Plate 59. The rack section on the Zugspitze railway, Bavaria

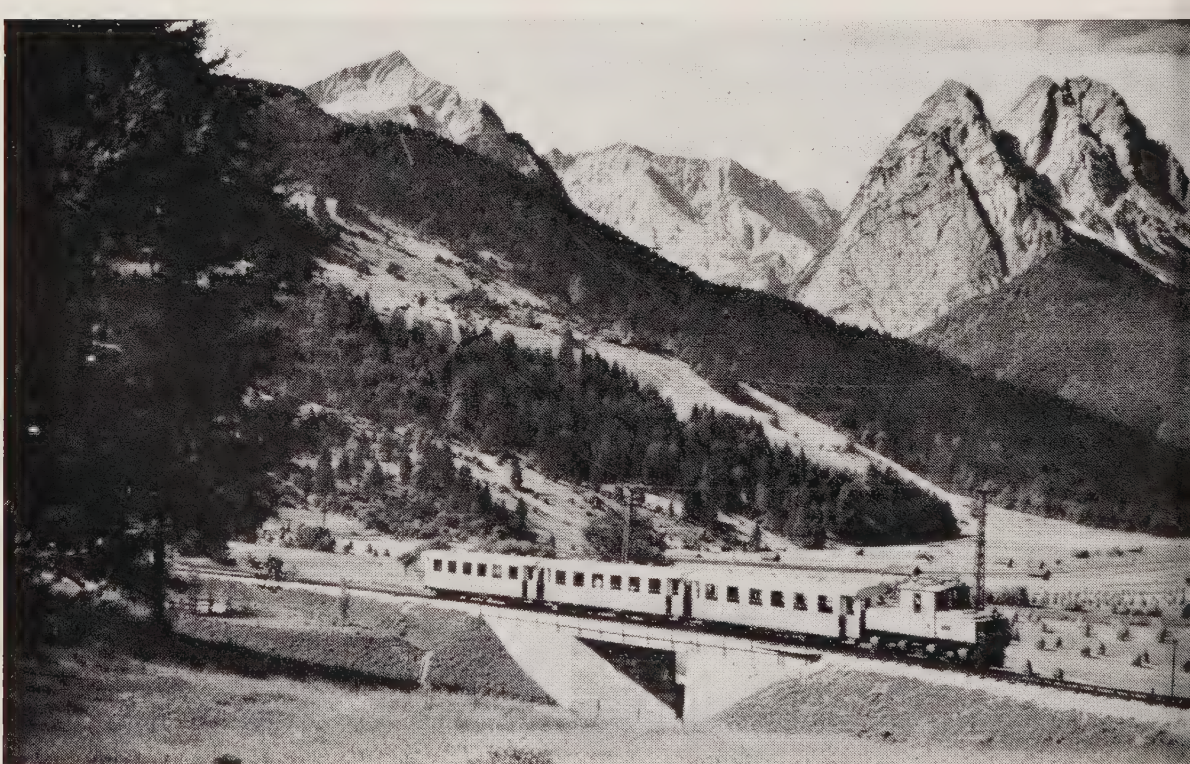

Plate 60. The adhesion section on the Zugspitze railway, Bavaria

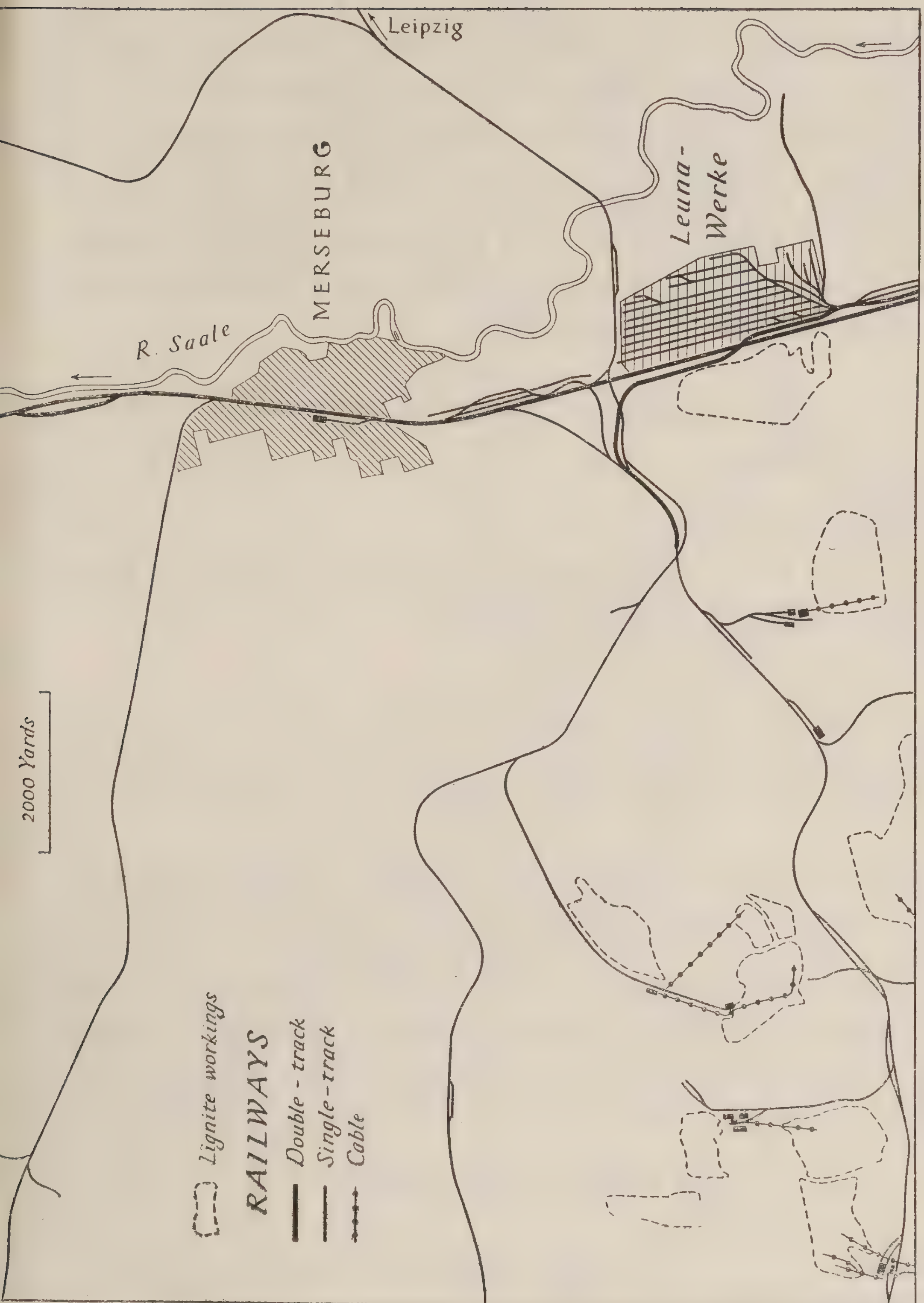

Fig. 92. Railways and industry: Merseburg and Leunawerke

Based on G.S.G.S. Series 4414, Germany, 1 : 25,000, Sheets 4636, 4637, 4736, 4737.

Leunawerke is one of the largest synthetic oil and chemical plants in Germany: the basis of its activities is the exploitation of the nearby lignite. The size of the works can be gauged from the fact that the town of Merseburg had a population of 31,000 in 1933.

south Germany, this railway carries a surprisingly low freight tonnage, but is followed by many express and fast passenger trains, which cover the journey in 1 hour 41 minutes.

Leaving Anhalter station, the railway runs in a south-westerly direction across the Fläming heath, in which section the greatest distance between any two stations is found, and crosses the Elbe by the large bridge south of the railway junction of Wittenberg (94·8 km.—58·9 miles). Running due south-west along the north edge of Düben heath, the railway crosses the Mulde at the junction of Bitterfeld (161·6 km.—81·8 miles), where it joins the shorter of the electrified routes between Leipzig and Magdeburg and runs southwards along a minor valley into Leipzig Hbf.

(51) *Magdeburg—Dessau—Bitterfeld*

Length: 86·3 (53·5 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Traction: Electric.
Maximum distance between stations: Güterglück to Zerbst, 8·3 km. (5·1 miles).
Marshalling yards: Magdeburg, Rosslau, Bitterfeld.
Locomotive sheds: Magdeburg, Dessau, Bitterfeld.
Mileage datum: Magdeburg.

Followed by fast electric trains which stop only at Dessau and Bitterfeld *en route* to Leipzig, this line also carries a considerable freight traffic, about five times that carried between Magdeburg and Halle.

The railway runs in a south-easterly direction, well to the east of the Elbe, across the unproductive and broken ground round Zerbst (42·7 km.—26·5 miles) to the important railway centres of Dessau-Rosslau (55·8 km.—34·6 miles) and Dessau (60·8 km.—37·7 miles). Between these two places it crosses the Elbe, and south of Dessau, keeping close to the greatly meandering Mulde river, reaches Bitterfeld, where it joins the direct line between Berlin and Leipzig.

(52) *Bebra—Erfurt—Halle*

Length: 210·7 km. (130·9 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Traction: Steam.
Maximum distance between stations: Fröttstädt to Gotha, 10·5 km. (6·5 miles)
Marshalling yards: Gerstungen, Erfurt, Weissenfels, Merseburg, Halle.
Locomotive sheds: Bebra, Gerstungen, Eisenach, Erfurt, Weimar, Naumburg, Weissenfels, Merseburg, Halle.
Mileage datum: Bebra.

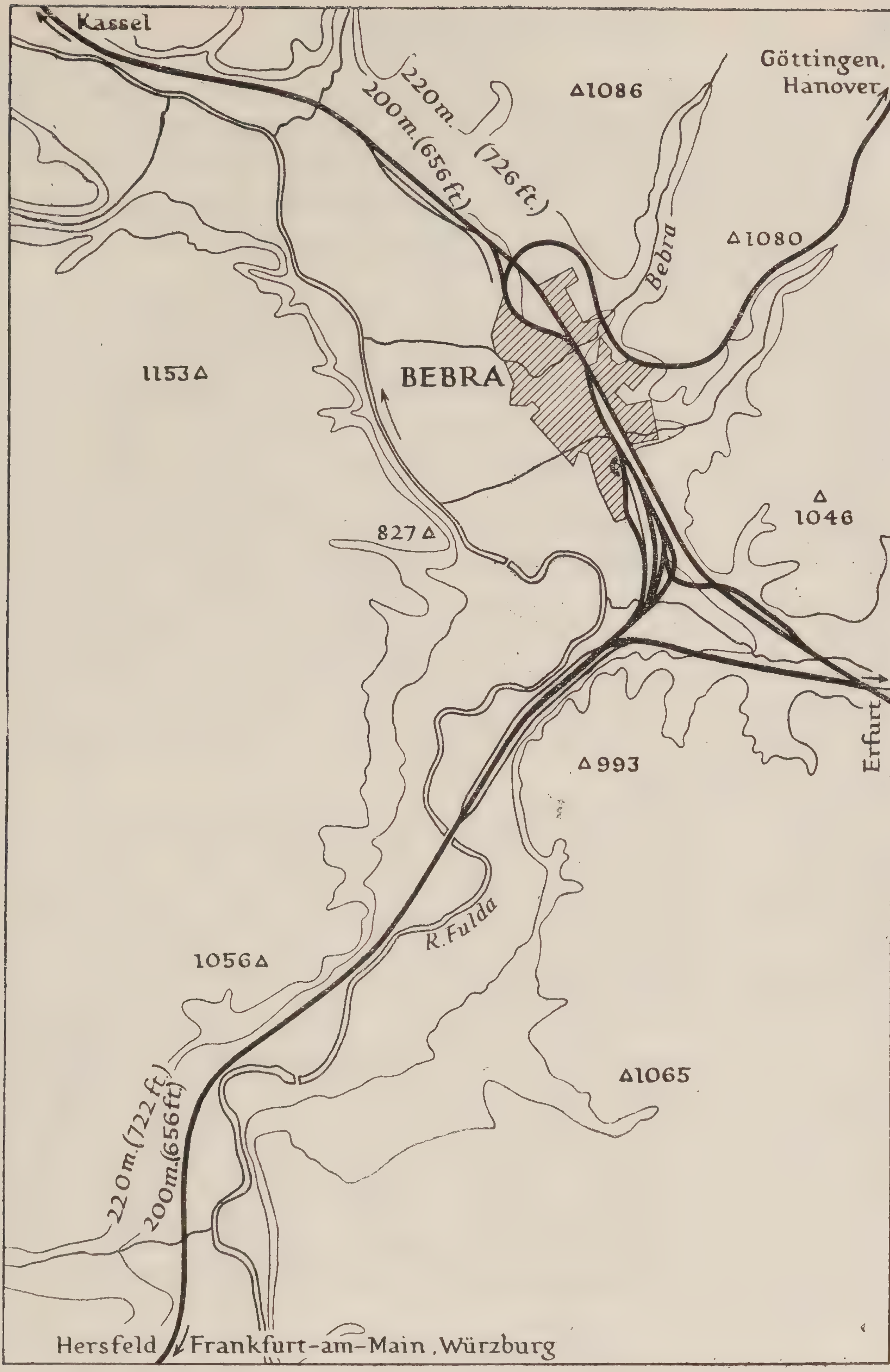

Fig. 93. Bebra

Based on G.S.G.S. Series 4414, Germany, 1 : 25,000, Sheet 5024.

Bebra is an important railway junction, for the double-track line from Hanover and Göttingen to Frankfurt-am-Main and south Germany crosses the double-track line from the Ruhr and Kassel to Erfurt and Saxony. The narrow valley-floors of the Fulda and its tributaries provide convenient sites for most of the lines, but a loop and considerable gradient is necessary for the connexion with the Göttingen line. Spot heights in ft.

This line runs from the junction of Bebra, where important lines from Hanover to Frankfurt-am-Main and from Kassel meet. It runs across the productive Thuringian Basin through Erfurt to the industrial centre of Halle and so carries a heavy freight traffic for both local and through needs. It also carries fast passenger traffic between Berlin and Frankfurt-am-Main.

The railway leaves the Fulda valley by climbing steeply up the Uife valley and passes through a tunnel about 3,300 ft. long under the ridge between the Uife and Werda valleys. Descending rapidly to Gerstungen (21·1 km.—13·1 miles), it keeps on the north side of the valley, and above the extensive water-meadows in the valley floor. Taking advantage of a right-angle bend of the Werda, a change of direction which is continued by the Hörsel, the railway passes through the rim of the Thuringian basin to Eisenach (45·1 km.—28·2 miles). The railway is confined in the narrow valley until it is clear of the Hörsel ridge at Sättelstädt (58·2 km.—36·1 miles). From here it runs across the undulating floor of the Thuringian basin, skirting the southern sides of Gotha (74·0 km.—46 miles) and Erfurt (102·1 km.—63·4 miles), for it keeps as much as possible in the minor valleys to reduce switchbacking.

At Weimar the railway is on the southern flank of the Ettessberge, which lies athwart the direct route between Erfurt and Halle, so it uses the Ilm valley to reach Grossheringen (151·9 km.—94·4 miles) on the river Saale, where it joins the Nuremberg line. From here the railway runs along the great curve of the Saale to Halle. As far as Weissenfels, a point marking the present limit of electrification on the Nuremberg line, the railway is able freely to cross the floor of the valley, but beyond Weissenfels it keeps to the west of the very marshy flood plain in which Saale swings about in great meanders. Passing through the industrial town of Merseburg (197·0 km.—122·3 miles), situated on a bluff overlooking the marshes both of the Saale and of the Luppe and Weisse Elster—tributaries of the Saale which enter from the east—and crossing the marshes where the firm land is closer, the railway enters Halle, which lies on the east side of the Saale.

(53)—*Leipzig foH*

Length: 161·2 km. (100·1 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Traction: Steam.
Maximum distance between stations: Altenburg to Lehndorf, 9·5 km. (5·9 miles).
Marshalling yard: Leipzig.
Locomotive sheds: Leipzig, Werdau, Reichenbach.
Mileage datum: Leipzig Hbf.

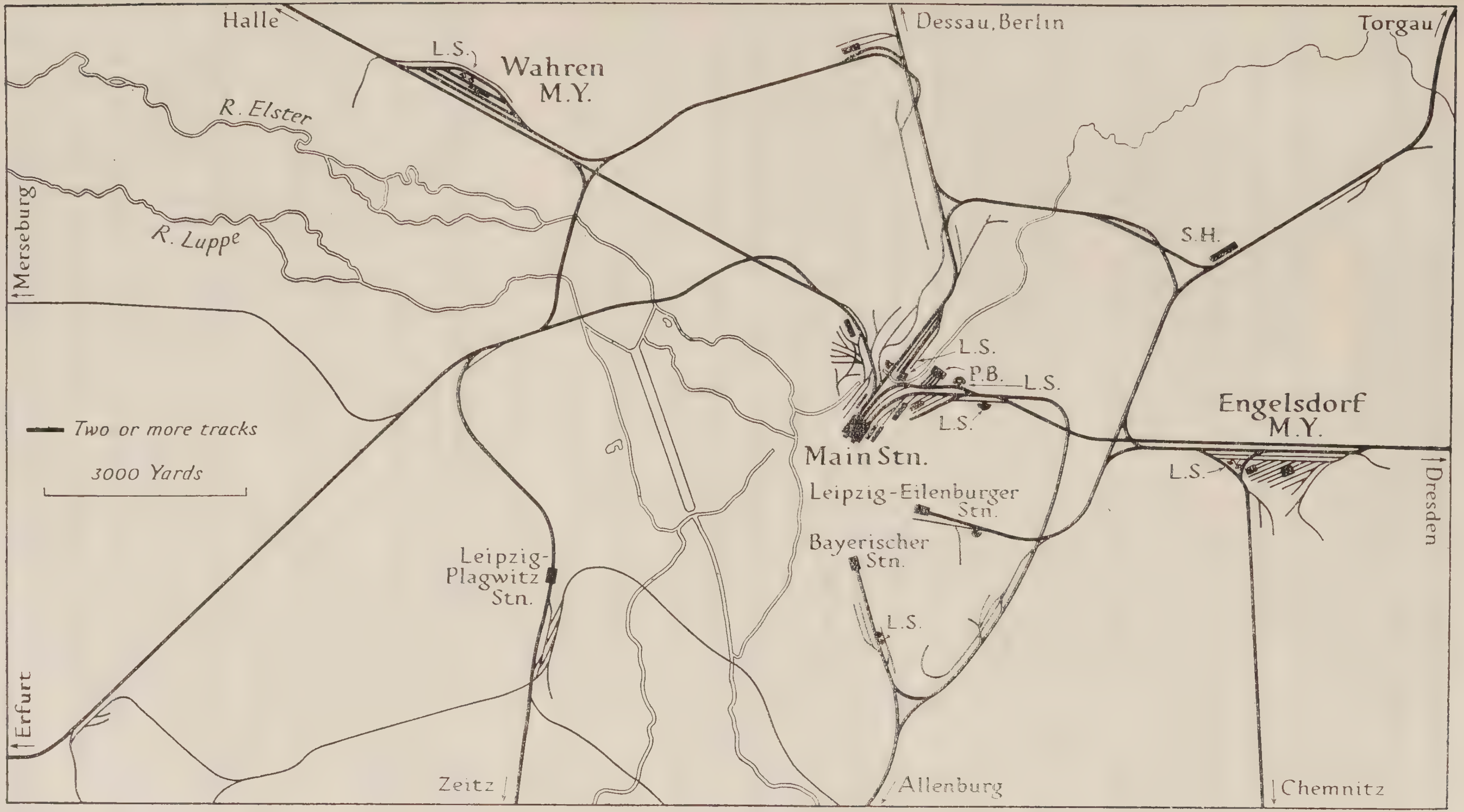

Fig. 94. Railway facilities of Leipzig

Based on G.S.G.S. Series 4414, Germany, 1 : 25,000, Sheets 4639, 4640.

L.S. Loco shed; M.Y. Marshalling yard; P.B. Post office station.
Leipzig is one of the most important railway centres in Germany.

Of the routes between Leipzig and the south this carries by far the greatest weight of freight traffic; it is used also by non-stop passenger trains on the Berlin to Munich run. Express trains cover the Leipzig—Hof section in 2 hours 21 minutes.

From Leipzig Hauptbahnhof, which is a terminal station facing north, trains run out by a curved line through the eastern suburbs and, crossing the Pleisse river, continue up the west side of the Pleisse valley, keeping well away from the floodplain, to Altenburg (34·5 km.—21·4 miles). The line crosses the Pleisse here and then climbs, close to the river, up the now very confined valley to Werdau (70·3 km.—43·7 miles).

Rising above the river to get an even up gradient, the railway crosses the watershed and descends to the hillflank above Reichenbach (87·4 km.—54·3 miles), crosses the Göltzch by a viaduct about 1,870 ft. long and switchbacks across several valleys and spurs to Plauen (112·6 km.—70 miles). Looping through this town the railway runs north for some kilometres in order to enter the Weisenthal. After ascending this valley, it crosses a low waterparting and runs down to Hof in the upper Saale valley. This route is intricate and difficult, but it permits the railway to cross the Vogtland upland which lies between the Saxony-Thuringian 'Bay' and the slopes of the Fichtel Gebirge on which Hof stands.

(54) *Halle—Falkenberg—Kottbus*

Length: 174·2 km. (108·2 miles).
Track: Double.
Maximum permissible axle-load: 20 tons.
Traction: Steam.
Maximum distance between stations: Finsterwalde to Gollmitz, 14·2 km. (8·8 miles).
Marshalling yards: Halle, Falkenberg, Kottbus.
Locomotive sheds: Halle, Eilenburg, Falkenberg, Kottbus.
Mileage datum: Leipzig Hbf.

This route carries both express passenger trains and a heavy freight traffic; it forms part of the most easily graded route between central Germany and Silesia.

From Halle the railway runs at the north edge of broken country through Delitzsch (27·1 km.—16·8 miles) to Eilenburg (49·6 km.—30·8 miles). Crossing the Mulde here the line turns to the north-east and goes to Torgau (77·3 km.—48 miles), where it crosses the Elbe, and on to the important junction of through routes at Falkenberg (95·3 km.—59·2 miles). From here the railway goes east-north-east through the wastelands of the Fläming where, on account of the

paucity of local traffic, the greatest distance between stations is found. Crossing several minor rivers, the line reaches Kottbus, where it makes connexion with the routes which link north-eastern and south-eastern Germany.

(55) *Dessau-Rosslau—Berlin* (*Schlesischer Bahnhof*)

Length: 118·8 km. (73·8 miles).
Track: (*a*) Rosslau to Wiesenburg, single;
(*b*) Wiesenburg to Berlin, double.
Maximum permissible axle-load: 18 tons.
Maximum gradient: 1 in 100 (minimum radius of curves, 300 m.).
Traction: Steam.
Maximum distance between stations: Jeber-Bergfrieden to Medewitz, 9·0 km. (5·6 miles).
Marshalling yards: Rosslau, Berlin.
Locomotive sheds: Rosslau, Berlin.
Mileage datum: Dessau-Rosslau.

Carrying a relatively heavy freight traffic, this line provides an alternative route between Magdeburg or Leipzig and Berlin despite the long section of single-track line. At Dessau and Rosslau at the confluence of the Elbe and Mulda, there is a triangular junction so that traffic can flow in either direction off the electrified line from Magdeburg to Leipzig. From Rosslau this line runs north-east across the Anhalt district, which lies partly in the Fläming waste area, to Wiesenburg (29·6 km.—18·4 miles). Running across the broken country of the morainic area of Zauche, the railway enters Berlin from the west and connects with the Stadtbahn (see p. 415).

North-east Germany

This region may be defined as lying eastwards of the meridional railway from Berlin to Stralsund and north of a line from Berlin to Frankfurt-an-der-Oder. It possesses the sparsest network of main lines in the Reich. From Berlin four lines radiate: north to Stralsund, north-east to Stettin and the Baltic coast, east-north-east to Königsberg, and east through Frankfurt towards Warsaw. Cutting across the radial lines are a number of cross-routes, of which only one (from Stralsund through Stettin to Frankfurt) joins all the radial routes with lines of *hauptbahn* standard. This simple pattern is related in part to a dominant feature of the relief—the broad, smooth-sided valleys. In more detail the railways avoid as much as possible the actual floodplain of the rivers and keep to the low bluffs which mark the edges of the various lake plateaux and of the tracts of sandy *geest*.

The pattern of the railways was not seriously broken by the

creation of the Polish frontier in 1919, for the lines remaining in Germany continue largely to fulfil the purposes for which they had been designed, i.e. to meet strategic needs. East Prussia, of course, after 1919 had no rail connexions with the rest of Germany which did not pass through Polish territory. Breaks which occurred through the formation of the Polish Corridor are as follows (from north to south):

West side		East side	
German station	*Polish station*	*Polish station*	*German station*
Richen	Zamostne	Münsterwalde	Marienwerder
Nawitz	Kantrschin	Sawdin	Freystadt
Deutsch Briesen	Konitz	Bischofswerder	Bischofswerder
		Radomno	Deutsch Eylau
Königsblick	Gertraudenhütte	Usdau	Bergling
Wierzebawn	Birnbaum	Schönwiese	Sakrau-Scharnau

The Treaty of Versailles established a frontier which was generally in harmony with the lay-out of the main railway lines. One of the few railway routes which needed to be built to complete the strategical, as well as commercial, operating network, was the line from Schwerin (on the Warthe) to Altbeelitz (near Kreuz), which was opened in 1936.

Physical Background

North-eastern Germany lies entirely in the North German Plain. To the north of the zone of sandy *geest* country are the relatively high morainic hills of the Mecklenburg Lake Plateau, rarely rising above 350 ft., the Baltic Heights and Lake Plateau, and East Prussia, cut through by the Oder and Vistula lowlands. A prominent relief feature is the Baltic End Moraine which, varying from a narrow crested ridge to a belt of irregular hills, rises to 550 ft. and so formed an appreciable obstacle to the building of the railways. South of this moraine, there is a confused tangle of hills, ridges and hollows, with numberless lakes and marshes, some of considerable size. These water areas formed a far greater obstacle to railway construction than the morainic hills, for they necessitated frequent detours and embankments, and raised problems of the adequacy of track foundations. Over wide areas soils are frequently based upon infertile outwash sands and gravels. Settlement is therefore of a low density, and stations are generally far apart.

Railway Divisions

This region is principally covered by four main operating divisions

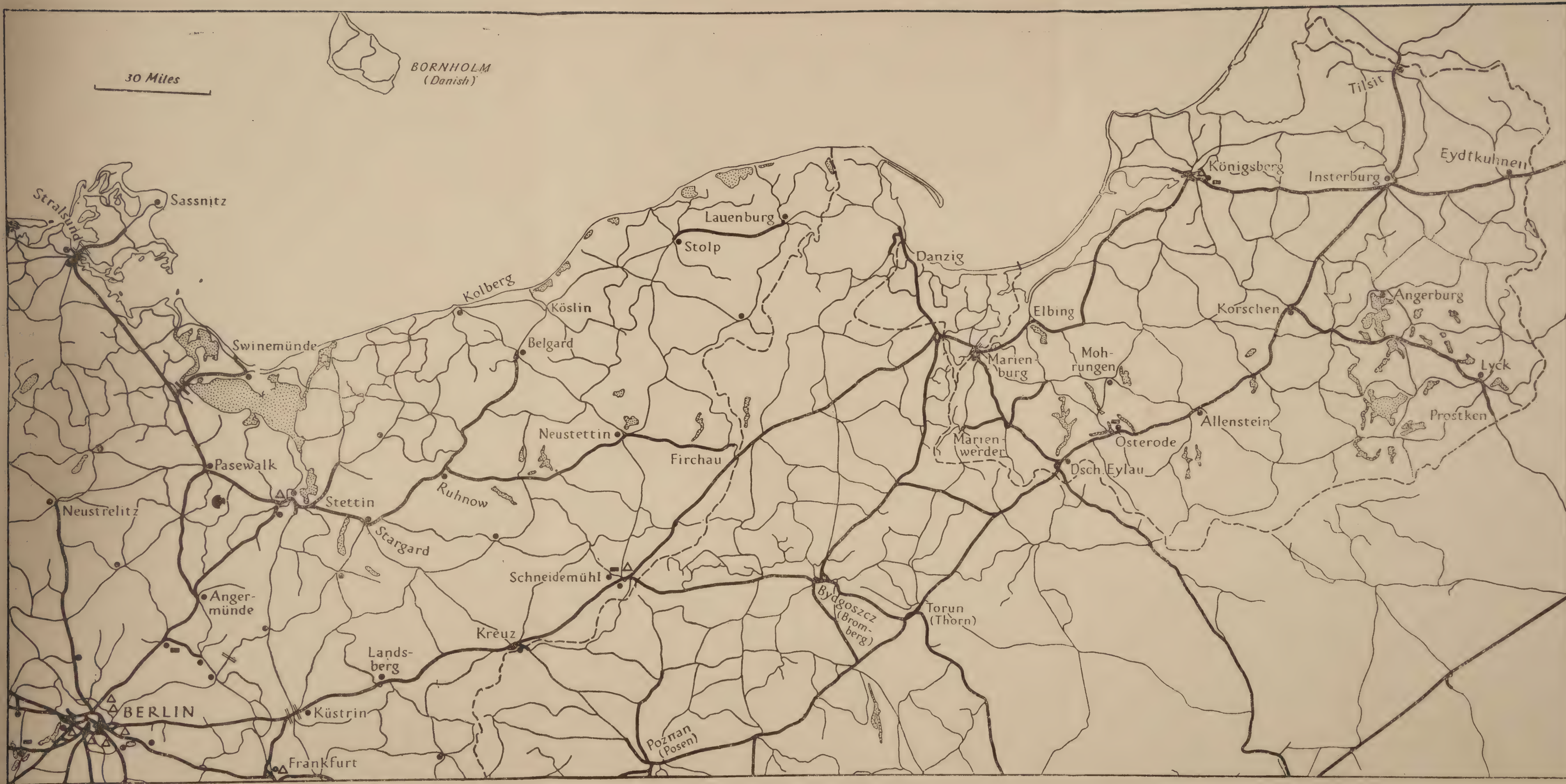

Fig. 95. The railways of north-east Germany

Based on G.S.G.S. Series 4072, Europe (Air), 1 : 500,000, Sheets N.E. 54/14, N.E. 54/18, N.E. 54/22, N.E. 52/14, N.E. 52/18, N.E. 52/22 (1940–2), and other official sources.

For key to symbols see Fig. 68.

[illegible]

[illegible]

(R.B.D.), viz. Berlin, Osten (centred on Frankfurt), Stettin and Königsberg, with intrusions from the Schwerin district to the west of Stettin. There is, in addition, a considerable mileage of privately-owned lines.

The railways of the R.B.D. of Stettin cover the sector between Berlin—Stralsund and Berlin—Küstrin—Stargard—Polish Corridor, and so include the eastern third of the Mecklenburg Lake Plateau, the Baltic Heights and Lake Plateau of Pomerania, together with the lowlands of the lower Oder and the Oder Marshes. Leaving the R.B.D. of Berlin at Oranienburg and Bernau, two routes run to Stralsund; the direct route via Neubrandenburg going across the Mecklenburg Lake Plateau, and the more easterly route via Prenzlau generally keeping near the edge of the plateau close to the Oder lowlands and the coast. From Pasewalk (west of Stettin) a *hauptbahn* line which crosses to the west, bifurcating at Strasburg (Uckermark) and forming part of the connexions between Stettin and the Elbe valley, has more than local value. Important branch lines run from Stralsund to the island of Rügen for the Sassnitz train ferry and from Ducherow to Swinemünde. At Angermünde, on the more easterly of the Berlin—Stralsund routes, the main line for Stettin takes off and, joining the line from Pasewalk, crosses the Oder lowland at Stettin. East of this port main lines radiate: north to Swinemünde and to Kolberg, north-east to Danzig (with alternative routes across the Baltic Heights between Meesom and Stolp), and south to Küstrin. The more southern of the alternative routes between Meesom and Stolp rises on to the Baltic End Moraine and there are more sinuosities to avoid lakes and sharper gradients than on the northern alternative.

The northern half of the R.B.D. of Osten operates the main lines (Berlin)—Strausberg—Schneidemühl—Firchau (for Danzig and Königsberg) and (Berlin)—Fürstenwalde—Frankfurt—Neu Bentschen—(Posen). The former main line takes advantage of the river Warthe, the right-angled tributary which joins the Oder near Küstrin, and skirting the southern edge of the Baltic Heights and Lake Plateau, passes by fairly easy gradients across the watershed near the Polish frontier. The route through Frankfurt to Poland, after using the Spree valley to reach the Oder, crosses the *Geest* of Sternberg towards Poland. Although the surface hardly reaches 200 ft. in height the numerous rivers have cut valleys in this sandy region and so created minor obstacles to railway construction. The principal cross-routes run south from Küstrin on either flank of the Oder

valley to Frankfurt; from Kreuz to Stargard; and from Schneidemühl to Neustettin.

East Prussia. The railways of the R.B.D. East Prussia take up the simple pattern of (i) two concentric routes running from west to north-east (viz. Marienburg to Königsberg, and Deutsch Eylau to Tilsit), and (ii) several routes radiating from Königsberg. Of these latter the most important are the lines running east to Eydtkuhnen (crossing the second concentric route at Insterburg), south-east to Prostken (crossing at Korschen), and south to Allenstein. There is also a cross-route from Marienburg to Warsaw which goes through Deutsch Eylau. The inner or northern concentric line, from Marienburg to Königsberg, follows an irregular course in avoiding the plateau areas of Ebinger Hohe and Stabelack. The outer or southern concentric main line of communication runs across the low plateau of the 'Preussische Seenplatte' which has been relatively easy to traverse despite numerous irregularities of relief. By turning to the north-east near Rothfliess towards Insterburg the railway avoids the larger of the Masurian lakes. The lines radiating from Königsberg vary in that the eastern line to Eydtkuhnen pursues a direct course, using the Pregel and Pissa valleys, whereas the other two routes are more sinuous: that to the south-east frontier post of Prostken deviates in order to pass between the larger lakes of the Masurian region, and that from Kobelbude, near Königsberg, to Allenstein deviates on account of a northward projecting tongue of the higher morainic plateau surface.

Engineering Structures

The broad open valleys and low plateaux obviate the necessity for long tunnels, but engineering works are not always on a small scale, owing to the breadth of the rivers, particularly the Oder, which have to be crossed. Many of these rivers, furthermore, in their lower courses break up into several streams, thus increasing the length and number of bridges necessary. (See table on opposite page.)

Railway Operating Features

The paucity of goods traffic is reflected in the small number of large marshalling yards outside the Greater Berlin area (Fig. 98). The only yards able to pass through more than 2,000 wagons a day are situated at Stettin, Frankfurt, Schneidemühl and Königsberg. There are further marshalling yards located at Königsberg, Marienburg and Allenstein, Pankow (Berlin) and Rummelsburg (Berlin). Repair

Principal Bridges

No. on map	Bridge	Over	Date built	Total length, ft.	No. of tracks	Construction
110	Frankfurt	R. Oder	1899	1,476	2	Steel girders, strengthened 1926–7
109	Küstrin	R. Oder	1926	787	2	Hog-backed steel girders
108	Küstrin	R. Warthe	1926	c. 312	2	Brick
107	Zäckerick-Alt Rüdnitz	R. Oder	1892	2,132	1	Hog-backed steel girders
104	Stettin	R. Oder (Ostoder)	1926	783	2	Steel girders; on the Stettin goods loop line
105	Stettin	R. Oder (Westoder)	1926–7	669	2	
103	Marienburg	R. Nogat	1889	643	2	Hog-backed steel girders.
102	Königsberg	R. Pregel	1926	650	4	Swing span, steel girders
119	Altefähr	Strelasund Channel	1936	1,772	1	Plate girders
120	Rügendamm	Zeigelgraben Channel	1936	459	1	Plate girders, 1 bascule span
106	Karnin	R. Peene	1932–4	?	2	1 horizontal lift span; 4 hog-backed girder spans
101	Hohenwaldeck	R. Rominte	?	?	?	Stone or concrete arches
100	—	Blindetal	?	656	?	Stone arches

From official sources.

The location of these bridges is shown in Fig. 51.

shops in the region, apart from those in the Berlin district, are situated at Königsberg (locomotives, coaches and wagons), Osterode (coaches and wagons), Schneidemühl (locomotives), Stargard (locomotives, coaches and wagons) and Eberswalde (coaches and wagons).

The train ferry to Trälleborg in Sweden uses the port of Sassnitz which comes in this region (see p. 150).

Traffic

Passenger Traffic. North-east from Berlin the line carrying most long-distance passenger trains is that through Küstrin, Kreuz and Schneidemühl to Poland, Danzig and East Prussia. The line to Stettin carries more trains as far as Angermünde, however, where a Stralsund service branches off. The alternative Stralsund route through Neustrelitz, although shorter, carries fewer services. From

Stettin relatively frequent services are provided in a north-easterly direction to Danzig, and in a south-easterly direction to Kreuz. On the cross-lines services are generally infrequent, averaging 4 to 8 trains per day.

The line carrying the heaviest traffic in East Prussia is that from Marienburg to Königsberg and Insterburg, which has about double the frequency of trains compared with the more inland line from Deutsch Eylau to Insterburg. The most important cross-lines from the coast to the south and east are from Marienburg to Deutsch Eylau, from Königsberg to Prostken and from Königsberg to Allenstein and Ortelsburg.

Goods. As with the R.B.D.s, it is found that the traffic districts (see p. 280) do not coincide with the regional divisions adopted for this account. The traffic districts now analysed are East Prussia; Königsberg, Pillau and Elbing; Pomerania; Pomeranian harbours; Posen—West Prussia. The districts of Berlin and Brandenburg which fall in part in this region are dealt with on p. 419.

Traffic, 1936 (*in thousands of tons*)

District	Local	Loaded to	Unloaded from	Loaded to	Unloaded from
		other German districts		foreign countries	
East Prussia	2,383	1,328	3,707	2	148
Königsberg, Pillau and Elbing	588	2,466	1,437	2	26
Pomerania	1,400	1,849	4,527	8	22
Pomeranian harbours	193	1,473	5,280	0	10
Posen—West Prussia	250	633	1,121	3	41

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1936*, Heft I, II, *passim.*

Route descriptions

(56) Berlin—Neustrelitz—Stralsund—Sassnitz Hafen
(57) Berlin—Stettin—Köslin—(Danzig)
(58) Angermünde—Stralsund
(59) Berlin—Küstrin—Schneidemühl—(Polish Corridor and Danzig) —Königsberg
(60) Berlin—Frankfurt-an-der-Oder—(Posen)—Allenstein—Tilsit

(56) *Berlin—Neustrelitz—Stralsund—Sassnitz Hafen*

Length: 277·6 km. (172·6 miles).
Track: Berlin to Oranienburg, two double tracks; thence to Neustrelitz double;
Neustrelitz to Stralsund, single;
Stralsund to Bergen, double;
Bergen to Sassnitz Hafen, single.
Traction: Steam (electric Berlin to Oranienburg on one pair of tracks).
Maximum distance between stations:
Neustrelitz to Blankensee, 14·9 km. (9·3 miles);
Düsterförde to Strelitz Alt, 10·0 km. (6·3 miles).
Marshalling yards: Berlin area.
Locomotive sheds: Berlin, Oranienburg, Neustrelitz, Stralsund, Stralsund Hafen, Sassnitz Hafen.
Mileage datum: Berlin (Stettiner Bahnhof).

This route between Berlin and Sassnitz Hafen is 16·5 km. (10·2 miles) shorter than that via Angermünde, but the gradients are more severe. From Stettiner Bahnhof the line proceeds north, over the Hohenzollern C. at Birkenwerder, to Oranienburg (29·3 km.—18·2 miles) and rising to about 260 ft. between Gransee (58·1 km.—36·1 miles) and Neustrelitz (100·4 km.—62·3 miles), crosses the summit level marked by the broad lake and forested belt of the Mecklenburg plateau. At Neustrelitz, which lies between the railway and Zierker See, the line swings east and north through Blankensee to avoid the depression occupied by Tollense See and its associated marshlands. The thinly populated nature of this section is revealed by the great distance between stations occurring either side of Neustrelitz. Neubrandenburg (135·6 km.—84·2 miles), although a smaller place than Neustrelitz, is a meeting place of six routes and a bridging point over a very marshy valley, and so is of some importance in the railway network of the region. For the next 33 km. (20·5 miles) the railway uses the Tollense valley, but avoids the marshy lands near the river. Crossing this river, where it joins the river Peene at the market town of Demmin (178·0 km.—110·6 miles), the railway drops to Stralsund (224·6 km—139·1 miles) across the northern slope of the plateau. From Stralsund the line crosses the Altefähr channel by an embankment and bridge and passing north-east across the island of Rügen, uses the narrow neck of land between the large and small Jasmunder Bodden, and ascending slightly, swings round the southern flank of the high ground of Jasmund to the bathing resort of Sassnitz, 1·7 km. (1 mile) short of 277·6 km. (172·4 miles). Here the railway connects with the rail-ferry service to Trälleborg (see p. 150).

(57) *Berlin—Stettin—Köslin—Gross Boschpol—(Danzig)*

Length: Berlin to Stettin, 134·7 km. (83·7 miles);
Stettin to Gross Boschpol, 304·6 km. (189·2 miles).
Track: Berlin to Belgard, double (parallel double track, electrified from Berlin to Bernau).
Belgard to Stolp, single; Stolp to Lauenburg, double; then to frontier, single.
Traction: Steam.
Maximum distance between stations:
Melchow to Eberswalde, 9·6 km. (5·9 miles);
Köslin to Schübben-Zanow, 11·7 km. (7·2 miles);
Freienwalde to Teschendorf, 11·0 km. (6·8 miles).
Marshalling yards: Berlin area, Stettin.
Locomotive sheds: Berlin, Eberswalde, Angermünde, Stettin, Stargard, Ruhnow, Belgard, Stolp, Lauenburg.
Mileage datum: Berlin (Stettiner Bahnhof).

Leaving Stettiner station, the line runs north-east across the edge of the lake area of Ükermark through Eberswalde (45·5 km.—28·2 miles) with its coach and wagon repair shops, and crosses the Hohenzollern C. By passing through Eberswalde and Angermünde the railway to Stettin avoids the Oder lowlands and floodplain. At Stettin (134·7 km.—83·7 miles), an important marshalling centre, the line skirts the southern edge of the town and crosses the two main arms of the Oder near the point of their entry into Dammscher See. Stettin, with a population of 254,000, is an important centre of traffic as it is a centre of machinery, shipbuilding and other industries (see p. 174), and the largest port and commercial centre on the German Baltic coast. Passing through Stargard (169·3 km.—105 miles), with its locomotive and rolling stock repair shops, and the market town of Belgard (280·3 km.—174 miles), and so north of the lake belt of Pomerania, the railway approaches the Baltic coast between Köslin (303·6 km.—188·6 miles) and Stolp (371·7 km.—231 miles), and crossing the frontier, approaches Danzig from the north. Although the line in Pomerania crosses numerous rivers none are deeply incised or broad, so there are no large bridges except on the goods relief line, built 1926–7, running south of the built-up area of Stettin.

(58) *Angermünde—Stralsund*

Length: 70·1 km. (43·5 miles).
Track: Double.
Traction: Steam.
Maximum distance between stations: Ducherow to Anklam, 12·1 km. (7·5 miles).
Marshalling yards: None.
Locomotive sheds: Angermünde, Pasewalk, Stralsund, Stralsund Hafen.
Mileage datum: Angermünde.

Leaving the Berlin to Stettin line at Angermünde, the railway skirts the eastern edge of the Mecklenburg lake belt to Pasewalk (61·5 km.—38·2 miles) on the river Ucker, crossing the *Nebenbahn* from Stettin to Neubrandenburg and Neustrelitz. From Pasewalk the route continues direct to Stralsund (170·1 km.—105·7 miles), crossing the two principal river barriers of the Peene and Ryck at Anklam (104·6 km.—64·1 miles) and Griefswald (138·9 km.—86·3 miles) respectively. At Stralsund, connexion is made with the direct line from Berlin to Sassnitz.

(59) *Berlin—Küstrin—Schneidemühl—(Polish Corridor and Danzig) —Königsberg*

Length: (*a*) Berlin to Firchau, 329·3 km. (204·5 miles);
(*b*) Firchau to Marienburg, 126·4 km. (78·5 miles);
(*c*) Marienburg to Königsberg, 144·3 km. (89·7 miles).
Track: Double.
Traction: Steam.
Maximum distance between stations:
(*a*) Kreuz to Filehne, 11·3 km. (7·0 miles); Filehne to Ascherbude, 12·4 km. (7·7 miles);
(*b*) Poland and Free City of Danzig; ?
(*c*) Braunsberg to Heiligenbeil, 12 km. (7·4 miles).
Marshalling yards: Berlin, Schneidemühl, Königsberg.
Locomotive sheds: Berlin, Küstrin, Landsberg, Kreuz, Schneidemühl (2), Marienburg, Königsberg.
Mileage datum: Berlin-Charlottenburg.

From Berlin the line runs east to Küstrin Alstadt and Küstrin Neustadt (96·8 km.—60·1 miles), where large bridges are necessary across the Oder and Warthe rivers (p. 395). These bridges, the former of steel girders and the latter with brick spans, were built in 1926 to cope with increasing loads. Keeping on the foot of the bluff north of the Warthe marshes to Landsberg, a traffic-producing centre with foundries and machinery manufacture, and to Follstein, the railway then strikes north-east to Schneidemühl (257·8 km.—160·2 miles), a railway junction with locomotive repair shops and a marshalling yard. The crossing of the river Küddow necessitates a large bridge. The railway continues to parallel the Polish frontier as far as Firchau (329·3 km.—204·6 miles). From this point it crosses the Polish Corridor for 108·9 km. (67·6 miles) and the southern part of the Free City of Danzig for 17·5 km. (10·8 miles). Entering East Prussia at Marienburg (455·7 km.—283·1 miles) by a long bridge over the Nogat, the line passes through the shipbuilding town of Elbing. From Marienburg to Königsberg the railway, after avoiding the marshes near Elbing, swings east and then north and approaches

the coast at Braunsberg (539·4 km.—335·1 miles), from which place it runs close to the shore of the Frisches Haff to Königsberg (601·0 km.—373 miles). This city, which has a large marshalling yard, and locomotive and rolling stock repair shops, and a wide range of industries supplying traffic to the railway as well as to the port, is entered after crossing the river Pregel by a long bridge of steel girders with two swing spans, rebuilt in 1926 to carry four tracks.

(60) *Berlin—Frankfurt-an-der-Oder—(Poznan)—Allenstein—Tilsit*

Length: (*a*) Berlin to Frankfurt, 92·5 km. (57·5 miles);
(*b*) Frankfurt to Bentschen, 122·7 km. (76·2 miles);
(*c*) Bentschen to Deutsch Eylau, 310 km. (192·6 miles);
(*d*) Deutsch Eylau to Insterburg, 206·9 km. (129·5 miles);
(*e*) Insterburg to Tilsit, 53·8 km. (33·4 miles).
Track: Double.
Traction: Steam.
Maximum distance between stations:
(*a*) Berkenbrück to Briesen, 8·0 km. (4·9 miles);
(*b*) Stentsch to Neu Bentschen, 10·8 km. (6·7 miles); Kunersdorf to Reppen, 12·1 km. (7·5 miles);
(*c*) Poland (26·7 km.);
(*d*) Bergenthal to Bischdorf, 13·9 km. (8·6 miles);
(*e*) Blumenthal to Grünheide, 10·5 km. (6·5 miles).
Marshalling yards: Berlin, Frankfurt.
Locomotive sheds: Berlin, Frankfurt (2), Deutsch Eylau, Osterode, Allenstein, Korschen, Insterburg, Tilsit.
Mileage datum: Berlin-Charlottenburg.

The railway from Charlottenburg station leaves the environs of Berlin by following the Spree valley as far as it takes up an east-west course, to cross the Oder at Frankfurt (92·5 km.—57·5 miles) by a long steel span bridge, strengthened 1926–7. The chemical, sugar-refining and paper works of Frankfurt bring traffic to the railway. The line traverses the sandy area of the *Geest* of Sternberg, to the Polish frontier at Neu Bentschen (174·1 km.—108·1 miles), and then crosses Poland through Poznan and Torun, to re-enter the Reich at Deutsch Eylau (525·2 km.—326·3 miles). At a distance of 28·6 km. inside the German frontier lies the market and saw-milling centre of Osterode. Passing among the lakes of East Prussia as far as the railway junction of Korschen, the railway then proceeds on a more direct course and descends slightly to Insterburg. Insterburg is a junction of some importance: several *Nebenbahnen* from the Lake Plateau enter, and the main line here described is crossed by the line from Königsberg to Kaunas. The railway has to bridge the Angerupp and Inster rivers and then, cutting across the marshes of the northern part of the province, reaches the frontier city of Tilsit on the Niemen.

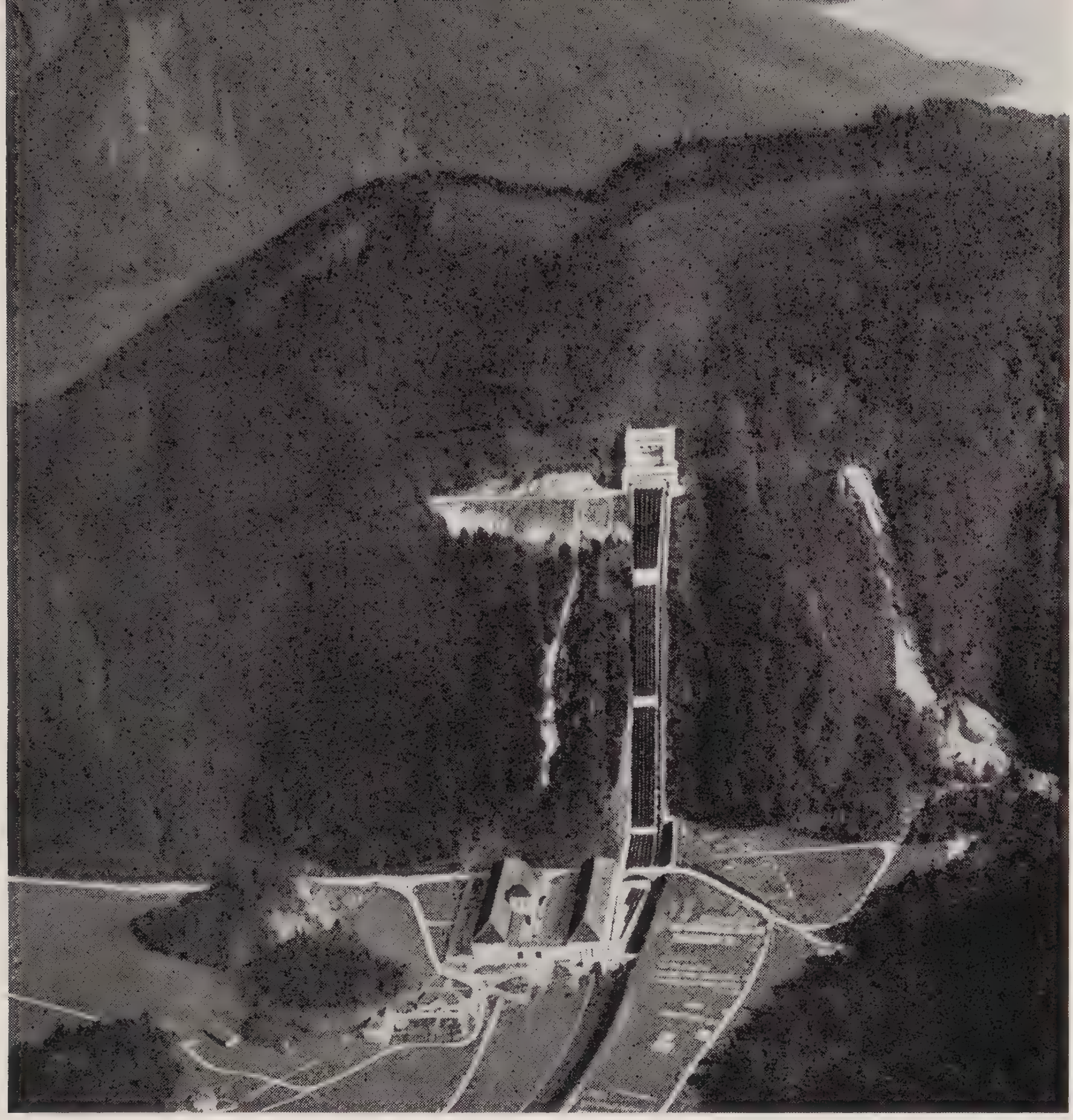

Plate 61. Walchensee hydro-electric power station

This power station supplies current to the electrified lines in Bavaria. The view, taken from above the tail race, shows the Walchensee in the background (i.e. to the south). The water is led by a 16-ft. tunnel through the Kessel Berg to a valve house, and then passes through a 1,430-ft. penstock at a gradient of 40°.

Plate 62. Munich: Süd Bahnhof, looking south

The station is in the foreground, and behind it lies the main town market hall. For map see Fig. 87

Plate 63. Leipzig: Hauptbahnhof
This is the largest station in Germany (see Fig. 94).

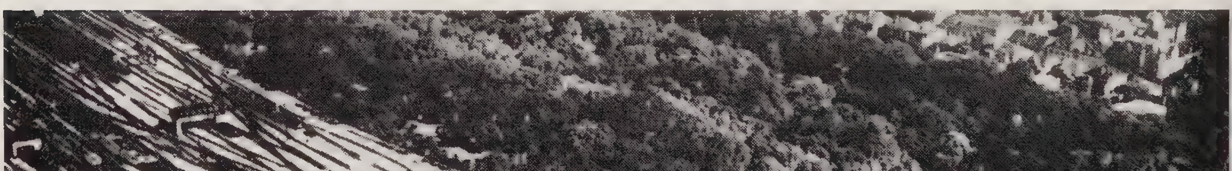

Plate 64. Stuttgart: Hauptbahnhof
The position of the station is shown in Fig. 86.

South-East Germany

This region extends east from Berlin to the Polish frontier and south from Frankfurt-an-der-Oder to the Upper Silesian coalfield. There is a well-marked north-west to south-west orientation of the lines, which, in the southern extremity, appear as confined between the South-eastern Sudetes and the Polish frontier. South of the Berlin to Frankfurt-an-der-Oder railway (see p. 400), lines strike south and east to Dresden, Görlitz, Liegnitz and Breslau, with cross-lines from west to east, of which the principal are Falkenberg—Kottbus—Glogau, Falkenberg—Liegnitz—Breslau and Dresden—Görlitz. South of the latitude of Breslau main lines run from north-west to south-east: Breslau—Oppeln—Gleiwitz, Hirschberg—Glatz and Ratibor. A former German line to the east of this line, and parallel to it, passed to Poland in 1919; it runs from Ostrowo to Beuthen. The simple pattern of the railways in Silesia is related to the trend of the Oder valley and the mountain edge of Bohemia. Breaks in natural route alignment arising from frontier changes are not numerous. Southwards from Bentschen on the Berlin—Posen line at the frontier the principal gaps are: Unruhstadt and Kolzig to Wollstein, and Saborwitz to Bojanowo. On the frontier with Czechoslovakia the breaks in route alignment are caused more by the high relief than by the political frontier.

Physical Background

This region extends from the *geest* country of Sternberg and Nieder Lausitz through the middle Oder basin and the Silesian 'Bay' to the Upper Silesian coalfields. On the southern edge of the region are the relatively abrupt slopes which form the north-east edge of the Bohemian 'diamond'.

The *Geest* of Nieder Lausitz, with its many peat bogs and forests, rises to about 450 ft., while the *Geest* of Sternberg attains only about half this altitude. Neither of these sandy areas offers a serious obstacle to railways. Surrounding them are broad marshy floodplains which are difficult to cross. In the middle Oder valley, with its wide flats of alluvium, the railway crossings have been sited where possible at points of narrowing: Frankfurt-an-der-Oder is situated at such a narrowing of the floodplain. The Silesian 'Bay' is a limestone plateau at an altitude of about 600 ft., with fertile loess soils growing cereals, sugar-beet and potatoes, which provide a large traffic

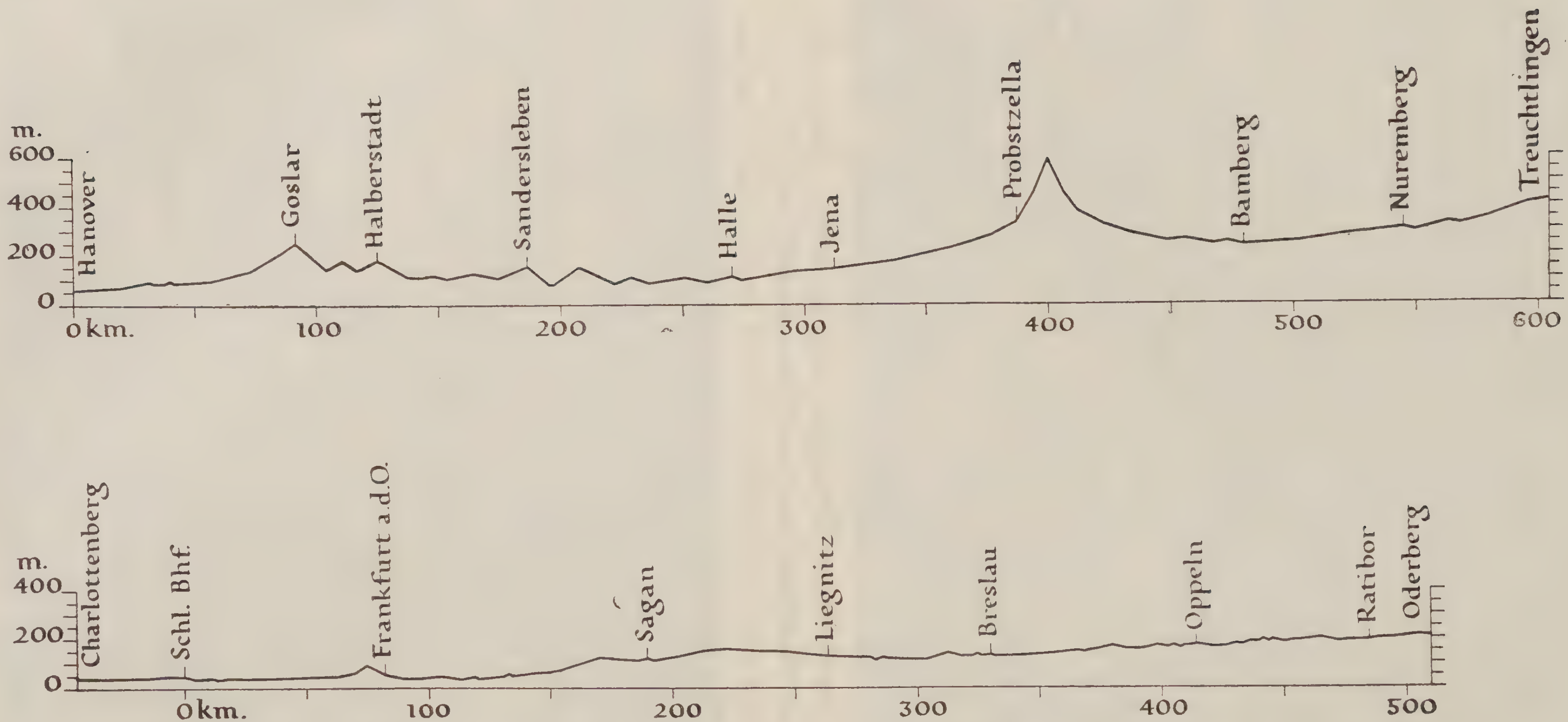

Fig. 96. Gradient profiles, (*a*) Hanover—Halle—Bamberg—Treuchtlingen; (*b*) Berlin-Charlottenburg—Oppeln—Oderberg

Based on Blum, —, 'Trassierungs-Grundsätze für Eisenbahnen ausserhalb der hoch industrialisierten Gebiete', *Verkehrstechnische Woche*, 27th year, Heft 38, pp. 552–660 (Berlin, 1933).

Vertical exaggeration approximately 100 times. The upper gradient profile covers a good deal of central Germany: at Goslar the line passes around the northern extremity of the Harz, then, after traversing the Saxony-Thuringian Bay and Thuringian Basin it crosses the Thuringian Forest at Probstzella to enter the Main valley. The lower gradient profile illustrates the terrain of an important line in south-east Germany (see p. 407) with an easy ascent of the Oder valley above Frankfurt-an-der Oder.

for the railways. This lowland is one of the main routeways of Germany. In the southern corner is found the productive coalfield of Upper Silesia.

Bounding the lowland zone, from west to east, are the Ober Lausitz, Iser Gebirge, Riesen Gebirge and the South-eastern Sudetes. The Ober Lausitz is an area of broken wooded country of moderate elevation, intersected by many single-track lines. The principal natural resource is kaolin, which is used for the Meissen pottery industry. The Iser Gebirge are cut by steep, narrow valleys, which cause the railways to centre on Görlitz. In the Riesen Gebirge are found the highest elevations of the south-east; the valleys and the railways converge on Hirschberg. The South-eastern Sudetes have a surface broken by sharp ridges enclosing a basin. The many intersecting valleys have facilitated railway building, although grades are difficult. In the south-east the mountains slope down to form the Moravian 'Gate', a low passage from Germany and Poland into Moravia (Czechoslovakia), which is followed by two railways from Silesia.

Railway Divisions

Within this region lie the whole of the operating divisions (R.B.D.s) of Oppeln and Breslau, the southern half of Osten and the eastern halves of Halle and Dresden R.B.D.s. In the Halle and Breslau districts there is a considerable mileage of privately-owned lines.

The railways of the southern half of the R.B.D. of Osten include the main lines running southwards from, or near, Frankfurt to Glogau, Sommerfeld and a point near Kottbus, with two cross-links —from Rothenburg to a point near Kottbus, and from the Polish frontier west of Lissa to Sagan. These lines serve the northern section of the middle Oder 'Basin'; the main lines avoid crossing the Oder or its broad floodplain as much as possible.

The eastern part of the R.B.D. of Halle links the main lines south from Berlin with those of the Dresden, Breslau, and Osten R.B.D.s. Cutting across the *Geest* of Nieder Lausitz to the Elster-Spree valley these lines have a more open network than those to the south. The eastern half of the R.B.D. of Dresden contains the principal railway at the foot of Erz-Gebirge and the railway following up the Elbe valley into Czechoslovakia; the crossing of these lines makes Dresden a most important railway centre.

The railway divisions of Breslau and Oppeln in the tongue of Germany between Poland and Czechoslovakia have two parallel lines

following the open Oder valley with numerous cross-lines and feeders towards the frontiers. In the extreme south-east is the very intricate network arising from the development of the Upper Silesian coal-field. The lines west of Breslau have important stretches electrified on account of the heavy gradients and heavy traffic (see p. 238 and Fig. 62).

Engineering Structures

The absence of routes across high mountain ridges has meant few tunnels, but the broad waters and deeply-cut valleys of the head-streams have necessitated the construction of a number of large bridges.

Principal Bridges

No. on map	Bridge	Over	Date built	Total length, ft.	No. of tracks	Construction
110	Frankfurt	R. Oder	1927	1,476	2	Steel spans
93	Köttewitz	Road	1937	302	2	Reinforced concrete
94	Königsbrück	Pulsnitztal	1899	695	1	Steel spans
95	Görlitz	Neissetal	1844–7	1,548	2	Granite arches
96	Bunzlau	Bobertal	1844–6	1,378	2	Sandstone arches
97	Jannowitz	R. Bober	?	262*	2	Stone arches
98	Lewin	Valley	?	328*	1	,, ,,
99	Deutsch-Rasselwitz	R. Hotzenplotz	1903–4	426*	1	Steel spans

* Approximate.

From official sources.

The location of these bridges is shown on Fig. 51.

Railway Operating Features

There is a concentration of goods traffic in the large marshalling yards of Dresden, Kohlfurt, Breslau and Gleiwitz, but elsewhere in the region, apart from Berlin and the coalfield, the absence of large yards indicates a lack of major load-producing industries. Others, apart from those in the vicinity of Berlin, are situated at Falkenberg, Kottbus, and Königszelt. Railway repair shops are situated at Berlin (see p. 417), Breslau (wagons), Lauban (electric locomotives, railcars and coaches), Oels (locomotives), Schweidnitz (wagons), Gleiwitz (locomotives and wagons), Oppeln (locomotives and rolling

stock), Dresden (rolling stock) and Kottbus (locomotives and rolling stock).

Traffic

Passenger Traffic. The flow of ordinary passenger trains to the south-east averages about 12 trains each way a day on the main lines, but greatly exceeds this figure near Berlin, Breslau and Dresden. Between Berlin and Frankfurt, in the winter of 1938, 58 trains operated, and between Frankfurt and Guben to the south about 26 trains. From Breslau to Liegnitz the number was 29, from Breslau to Oppeln 24 and on the electrified sector to Dittersbach only 17 trains.

South of Berlin to Zossen there are about 50 trains daily, but this number drops to only 12 between Elsterwerda and Dresden, which is about 5 more than on the alternative route via Falkenberg. There is a much heavier traffic (22 trains each way) to Leipzig. From Dresden 14 trains run to the frontier post near Bad Schandau.

On the three principal cross-lines from west to east the passenger traffic varies from about 20 trains between Dresden and Görlitz to 10 trains between Falkenberg and Kohlfurt and about 15 from Falkenberg to Kottbus and Sagan.

Goods Traffic. The flow of goods traffic presents several striking features (Fig. 62). There is, naturally, little traffic originating in Berlin, and the heaviest traffic entering that city is coal and other commodities by the line from Oppeln through Breslau and Kottbus. From this stream of traffic a certain amount takes off at Sagan and moves to Küstrin and there joins the north-east flow by the line through Schneidemühl. The movement round Dresden is low on any one route, although the aggregate is comparatively high. Of the three cross-lines there is a difference compared with the passenger-goods train movement, because the northern route through Kottbus is the most important and the southernmost route is the least, with about half the tonnage. The central route through Kohlfurt is intermediate in density of goods traffic.

Of the traffic districts which fall partly within this region, Berlin and Brandenburg are dealt with on p. 419; Saxony, Dresden, and Merseburg and Erfurt on p. 380; and Posen and West Prussia on p. 396. The traffic districts considered here—Upper Silesia, Breslau, and Lower Silesia—all fall completely within the region.

Traffic, 1936 (*in thousands of tons*)

District	Local	Loaded to (other German districts)	Unloaded from (other German districts)	Loaded to (foreign countries)	Unloaded from (foreign countries)
Upper Silesia	1,018	14,426	1,794	1,221	279
Breslau	114	691	2,453	15	47
Lower Silesia	8,035	9,280	5,669	636	473

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1936*, Heft I, II, *passim.*

The traffic of these districts varies considerably in character. All have a very unequal balance; in the two provinces loadings greatly exceed unloadings, with the greater discrepancy for the Silesian coalfield, while in the city of Breslau, as would be expected, the unloadings are greater, for the bulk consumption needs of the city exceed the weight of the product of its industries. The same is true of the foreign traffic. With the local traffic, Lower Silesia greatly exceeds that of Upper Silesia, partly on account of its greater area and partly because of its more varied economy.

In Silesia the western uplands carry on dairying and minor industries, wheat and beet are produced in the central area, while the eastern zone is relatively unproductive country with rye and potato cultivation. Superimposed on this economy are the industrial areas of Breslau and the Upper Silesian coalfield, and the minor industrial centre of the Waldenburg coalfield.

Lower Silesia exports fuel, including coal and lignite briquettes, and worked and artificial stone. Imports include salt, sulphuric acid, benzin and fertilizers from the Merseburg industrial area; basic slag from the Ruhr industrial region and bauxite clays from Hungary.

From Upper Silesia coal and coke flow out widely over many parts of Germany, and into central and south-east Europe. The region also exports lime fertilizer to north-east Germany and Saxony. Of the imports, scrap iron, pitprops, and potash fertilizer (from the central Germany industrial area) are the most important. It is significant that there is no big movement of foodstuffs, for there is a strong agricultural background to the district. (See table on opposite page.)

Into Breslau the main movements are worked stone, sand, sugar-beet and coal. There is no large export.

Coal and Coke Loadings (over 10,000 tons) in Upper Silesia, 1936 (in thousands of tons)

Destination	Coal	Coke	Destination	Coal	Coke
East Prussia	273·2	41·1	Magdeburg and Anhalt	137·5	38·5
East Prussian ports	127·6	—	Merseburg and Erfurt	219·1	23·0
Pomerania	600·9	65·0	Thuringia	133·3	10·7
Pomeranian ports	2,621·4	211·1	Saxony	745·7	80·0
Mecklenburg	231·9	21·8	Leipzig	106·2	—
Baltic ports from Rostock to Flensburg	98·7	—	Hesse-Nassau	38·6	—
			Württemberg	85·2	—
Oldenburg	28·8	—	S. Bavaria	384·0	38·7
Hanover and Hildesheim	165·7	24·4	Munich	107·7	28·2
			N. Bavaria	476·0	52·4
Posen—West Prussia	169·3	14·8	S.E. Europe	22·0	10·5
Breslau	745·2	24·1	Czechoslovakia	761·1	—
Lower Silesia	2,186·0	73·5	Austria	93·6	29·3
Berlin	796·3	50·9	Switzerland	24·0	—
Brandenburg	864·6	61·8	Italy	24·5	—

Route descriptions

(61) Berlin—Frankfurt-an-der-Oder—Liegnitz—Breslau—Oppeln—{Oderberg / Gleiwitz}

(62) Berlin—Reppen—Glogau—Breslau

(63) Berlin—Kottbus—Sagan

(64) Berlin—Uckro—Dresden—(Prague)

(65) Falkenberg—Liegnitz

(66) Dresden—Görlitz—Glatz

(61) *Berlin—Frankfurt-an-der-Oder—Liegnitz—Breslau—Oppeln—{Oderberg / Gleiwitz}*

Length: Berlin to Breslau, 340·8 km. (211·7 miles);
Breslau to Oderberg, 180·8 km. (112·3 miles);
Heydebreck to Gleiwitz, 37·1 km. (23 miles).

Track: Double throughout after the quadrupled section from Berlin to Erkner.

Traction: Steam, except for parallel electrified section from centre of Berlin to Erkner.

Maximum distance between stations:
Oberleschen to Mallmitz, 15·0 km. (9·3 miles);
Mallmitz to Sagan, 11·2 km. (6·9 miles);
Oderfest to Gogolin, 10·1 km. (6·2 miles);
Gogolin to Odertal, 10·9 km. (6·7 miles).

Marshalling yards: Berlin, Frankfurt-an-der-Oder, Breslau, Gleiwitz.

Locomotive sheds: Berlin, Erkner, Frankfurt-an-der-Oder (2), Guben, Sommerfeld, Sagan, Arnsdorf, Liegnitz, Breslau (2), Brockau, Brieg, Oppeln, Kandrzin, Nensa, Ratibor, Gleiwitz.

Mileage datum: Berlin-Charlottenburg.

This line leaves Berlin-Charlottenburg station and runs to Frankfurt by the route described on p. 400, and rising to 315 ft. over a low watershed at Rosengarten (87·1 km.—54·1 miles) descends sharply to Frankfurt-an-der-Oder (92·5 km.—57·4 miles). At Frankfurt, a railway and power centre, the line leaves that to East Prussia and runs south-south-east on the west bank of the Oder and its tributary the Neisse to Guben. The line rarely approaches very closely to the river, for it clings to the edge of the bluff overlooking the flood-plain. At Guben, a cloth-manufacturing town, the railway turns to the south-east and, following the river Lubst, which it crosses and re-crosses, ascends with a gradient of 1 in 200 to a local summit of 404 ft. at Friedersdorf (181·5 km.—112·7 miles). For the next 20 km. it drops gently into the valley of the Tschirne, which it crosses near the cloth-manufacturing town of Sagan (201·3 km.—125 miles) and then ascends the valley of the Bober between Saganer Heide and the river. From Sagan to Liegnitz the line runs almost dead straight for 74·3 km. (46·1 miles) through Sprottau Forest and the headwaters of tributaries of the Schwarzwasser, with a summit of 515 ft. east of Oberleschen (227·5 km.—141·3 miles). Liegnitz (275·6 km.—171 miles), with its machinery and piano manufactures, wool warehousing and vegetable growing, has valuable traffic-producing activity; the line turns abruptly to the east, drops gently to the valley of the Oder and, crossing the tributaries Weistritz and Lohe, enters Breslau (340·8 km.—211·7 miles), which is the largest traffic-handling centre in this region.

Keeping for 82 km. (51 miles) on the west bank of the Oder, and its parallel tributary the Ohle as far as the tobacco-handling town of Ohlam (377·3 km.—234·4 miles), the line ascends on the whole, with, however, a number of short, sharp descents, as far as the frontier post of Oderberg, near which the summit of the line (873 ft.) is reached. To attain this height the line crosses the Oder at the cement and leather centre of Oppeln (422·5 km.—262·5 miles) and runs about 3 km. east of the river on the edge of the bluff to Ratibor (496·3 km.—308·6 miles), and finally re-crosses the Oder at Oderberg (521·6 km.—324·1 miles), where the river forms the international frontier.

From Heydebreck, near Kandrzin, which lies on the south bank of the Klodnitz, a tributary of the Oder, the line to Gleiwitz leaves the central railway artery and keeping on the south and west bank of the Klodnitz as far as Labana, just north of Gleiwitz, runs into the eastern suburbs of the coal and iron centre of Gleiwitz (558·7 km.

Fig. 97. The railways of south-east Germany

Based on G.S.G.S. Series 4072, Europe (Air), 1 : 500,000, Sheets N.E. 52/14, N.E. 50/14, N.E. 50/18 (1940–2), and other official sources.

For key to symbols see Fig. 68.

—347·1 miles). East of this point numerous lines radiate to tap the Upper Silesian coalfield, and consequently Gleiwitz forms the natural focus for a large modern marshalling yard.

(62) *Berlin—Reppen—Glogau—Breslau*

Length: 234·5 km. (145·7 miles).
Track: Double, except for single track between Neusalz and Glogau.
Traction: Steam.
Maximum distance between stations:
Kunzendorf to Wohlau, 14·2 km. (8·8 miles);
Beuthen to Alteichen, 12·0 km. (7·4 miles).
Marshalling yards: Breslau.
Locomotive sheds: Grünberg, Glogau, Breslau (2).
Mileage datum: Reppen.

Leaving the main Frankfurt-an-der-Oder to Posen line a little to the west of Reppen, this line strikes south-east across the lake-studded *geest* country of Sternberg to the middle Oder valley, and crosses the river at Deutsch Nettkow. Running across the neck of a large swing of the Oder, using for part of its course the valleys of minor tributaries, it again approaches the main river closely at Neusalz (92·7 km.—57·5 miles) and runs from there to Glogau (124·5 km.—77·3 miles) just above the floodplain. From Glogau to Steinau (164·8 km.—102·4 miles) it again strikes across the neck of an eastward swing of the Oder, and this time uses the valley of the Schwarzwasser to attain a local summit near Alt Raudten, then drops down to Steinau, cutting across minor river valleys. At Steinau, which engages in earthenware manufacture, saw-milling and sugar refining, the line turns north-east to cross the Oder at right angles, and then resumes its south-easterly course to Breslau (234·5 km.—145·9 miles), which it approaches by crossing the Oder again, this time at Kranz. In the last few miles before Breslau the railway has to cross the Weistritz and Lohe as well as other smaller west-bank tributaries of the Oder.

(63) *Berlin—Kottbus—Sagan*

Length: (*a*) Berlin to Kottbus, 114·7 km. (71·2 miles);
(*b*) Kottbus to Sagan, 72·2 km. (44·8 miles).
Track: Double, with parallel electrified double-track as far as Grünau.
Traction: Steam.
Maximum distance between stations:
(*a*) Teupitz-Gross Köris to Gross Besten, 10·0 km. (6·2 miles);
(*b*) Forst to Teuplitz, 16·0 km. (9·9 miles).
Marshalling yards: Berlin, Kottbus.
Locomotive sheds: Berlin, Lübben, Kottbus, Forst, Sagan.
Mileage datum: Berlin-Görlitzer Bahnhof.

Leaving Berlin from Görlitzer station, this railway winds through the lake cluster of Mittelmark near Wusterhausen, and proceeds across the Dahme valley to Lübben (74·6 km.—46·3 miles), which is situated on the Spree. Curving south and east round the marshes of Spree Wald the line reaches the rail centre of Kottbus (114·7 km.—71·2 miles), where the Spree is crossed. Proceeding east-south-east the line crosses the Neisse, a tributary of the Oder, at the cloth-making town of Forst (138·7 km.—86·2 miles), and runs across the head valleys of minor tributaries, to join the main Frankfurt—Breslau railway at Sagan (184·9 km.—114·8 miles), a tourist centre with a small cloth industry.

(64) *Berlin—Uckro—Dresden—(Prague)*

Length: (*a*) Berlin to Dresden, 179·6 km. (111·6 miles);
(*b*) Dresden to Bad Schandau, 39·7 km. (24·6 miles).
Track: Double, with two sets of double track from Dresden to Pirna.
Traction: Steam.
Maximum distance between stations:
(*a*) Brenitz-Sonnewalde to Dobrilugk-Kirchhain, 9·3 km. (5·8 miles);
(*b*) Kurort Rathen to Königstein, 6·2 km. (3·8 miles).
Marshalling yards: Berlin, Dresden.
Locomotive sheds: Elsterwerda, Dresden (3), Pirna.
Mileage datum: Berlin (Anhalter Bahnhof).

Leaving Anhalter Bahnhof the line runs south across the lake-studded morainic area of Mittelmark to Uckro (76·1 km.—47·2 miles), where it lies on the low waterparting between the Elbe and Spree drainage basins. Proceeding south and then south-west, it crosses the Schwartze Elster at Elsterwerda (122·8 km.—76·3 miles) and turns due south, to the east of the Röder river, to Grossenhain (141·4 km.—87·8 miles), a woollen textile centre, and on to near Coswig, at which place it turns south-east and, keeping just off the floodplain of the Elbe, enters the northern suburbs of the regional centre of Dresden (179·6 km.—111·6 miles). Here, joined by lines from the east and north-east, it turns and crosses the Elbe and runs direct, again at the foot of the bluffs bounding the floodplain, to Pirna (196·6 km.—122·1 miles). From Pirna to the Czechoslovak frontier (228·6 km.—142 miles) the line closely hugs the west bank of the river, which here is flowing deeply entrenched in the Elbe gorge. In the 11 km. of this meandering stretch of the railway there is only one branch, a line which, crossing the Elbe at Wendisch Fähre, opens the Sebnitz valley to rail traffic.

(65) *Falkenberg—Liegnitz*

Length: (*a*) Falkenburg to Kohlfurt, 147·9 km. (91·9 miles);
(*b*) Kohlfurt to Liegnitz, 70·9 km. (44 miles).
Track: Double.
Traction: Steam.
Maximum distance between stations:
(*a*) Wehrkirch to Nieder Bielau, 9·9 km. (6·1 miles);
(*b*) Siegersdorf to Bunzlau, 13·1 km. (8·1 miles).
Marshalling yards: Falkenberg (2), Kohlfurt.
Locomotive sheds: Falkenberg, Elsterwerda, Hoyerswerda, Kohlfurt, Arnsdorf, Liegnitz.
Mileage datum: Falkenberg.

From Falkenberg, a small settlement but an important junction of routes from Berlin, Magdeburg, Halle, Leipzig, Chemnitz and Dresden, this important cross-route between the industrial areas of Saxony and Silesia runs south and east. To the south is the line from Dresden to Görlitz, with its heavy gradients, while to the north is the circuitous route from Breslau via Kottbus. These three routes, apart from odd cross-links, are the only main lines from east to west which lie between Berlin and the bounding mountains of the Bohemian 'diamond'. This route has been selected for description out of the three because on the balance of length and gradient it is the most favourable for passing heavy traffic. The northern alternative is not described apart from the section from Sagan to Breslau (p. 408) and the southern route is described on p. 412.

From Falkenberg the line runs direct across Röder to Liebenwerda (14·3 km.—8·8 miles), where it crosses the Schwartze Elster. It then curves south and east along the southern foot of the morainic area of Görden Forest, and passing north of Elsterwerda (23·2 km.—14·4 miles), crosses the canalized Elster and its adjoining floodplain to enter the railway junction of Ruhland (40·6 km.—25·2 miles). It then proceeds across the lake-studded region of Ober-Lausitz, an area of lignite production, and running east-south-east crosses many parallel rivers, e.g. the Neisse, Queis and Bober. The line passes through areas of heath such as the Görlitzer Kommunal Heide, where stations are widely spaced. Crossing broken country where the drainage changes from south-north to west-east, it joins the main Frankfurt-an-der-Oder to Breslau line at Arnsdorf, 8·6 km. (5·3 miles) north-west of Liegnitz.

(66) *Dresden—Görlitz—Glatz*

Length: (*a*) Dresden to Görlitz, 106·0 km. (65·8 miles);
(*b*) Görlitz to Waldenburg-Dittersbach, 124·5 km. (77·3 miles);
(*c*) Waldenburg-Dittersbach to Glatz, 52·7 km. (32·7 miles).

Track: Double.
Traction: Steam, except from Görlitz to Waldenburg-Dittersbach (electric).
Maximum distance between stations:
(*a*) Seitschen to Bautzen, 8·1 km. (5 miles);
(*b*) Reibnitz to Hirschberg, 11·6 km. (7·2 miles);
(*c*) Neurode to Mittelsteine, 7·6 km. (4·7 miles).
Marshalling yards: Dresden, Görlitz, Waldenburg-Dittersbach.
Locomotive sheds: Dresden (3), Hautzen, Görlitz (2), Lauban, Hirschberg, Dittersbach, Glatz.
Mileage datum: Dresden Hbf.

From Dresden Hauptbahnhof the line runs north-west to the waterparting between the Priessnitz and Schwartze Röder valleys and then, turning east, follows the latter valley and its continuation, that of the Wesnitz river, to Bischofswerda (41·1 km.—25·5 miles). Then, passing into the valleys formed by the headwaters of tributaries of the Spree, it crosses this river at Bautzen (60·1 km.—37·3 miles). In the settlements of these upper valleys minor industries such as glass, linen and paper manufacture are carried on. The line proceeds by an irregular course through Löbau (81·8 km.—50·8 miles) to Görlitz (106·0 km.—65·8 miles). The course obtained by taking advantage of river valleys in an upland area, markedly contrasts with the direct routes followed by the west-east railway only 20 miles further north. Entering on the south side of Görlitz and crossing the Neisse, here the railway has an easier run to Lauban (131·6 km.—81·8 miles), bridging point of the Queis. From Lauban the line, now running south-east, has a difficult country of steeper slopes to cross to the Bober valley at Hirschberg (183·6 km.—114·1 miles). This town is a centre of cellulose, wool, linen and metal industries. For the 31·9 km. (19·7 miles) from Hirschberg to the coal town of Fellhamer the line rises sharply, even though it follows the valley of the Bober and its tributary the Lassig, making frequent crossings of these rivers so as to obtain the most favourable gradients. Crossing a watershed here the line passes to Waldenburg-Dittersbach (230·5 km.—143·2 miles), a minor coal-mining centre, where the electrified line to Breslau takes off, and then descends to the headstream of the Westriz. Climbing out of this valley, which lies between the Eulen Gebirge and Falken Gebirge, the line reaches its summit near Königswalde (246·3 km.—153·2 miles). After dropping sharply to the east side of the Walditz valley, it then proceeds into the Steine valley; crossing this river and its tributary the Biele, it reaches Glatz (281·5 km.—174·9 miles), which is a minor engineering centre.

Berlin

Elevated and Underground Railways

During the nineteenth and twentieth centuries Berlin spread widely by adding suburbs beyond the former Customs wall. This expansion was only rendered possible by the provision of a modern transport system. The first route of a tramway network was opened in 1865, and later came an underground railway system. The Electric Elevated and Underground Railways Company of Berlin was formed in 1877 but did not commence operation until 1902, when the 10·1 km. (6·3 mile) section (partly elevated and partly underground) between Warschauer-Brücke and Zoologischer Garten, with a short branch to Potsdamer-Platz, was opened. In 1926, the municipality acquired a controlling interest in the various lines built by the company; in the following year a working agreement was drawn up between the Elevated and Underground Railways, the tramways and the omnibus companies; finally, in 1928, the three companies were amalgamated to form the *Berliner Verkehrs Aktiengesellschaft* (Berlin Transport Company).

The Elevated and Underground Railways are worked on the third-rail system at 750 to 780 volts D.C. and operate five main routes with a number of feeder branch lines. The company operates 625 motor coaches. (In 1937 there were 1,562 street tramcars and 1,266 trailer cars, 11 trolley buses and 630 omnibuses in use.) The function of the bus in the transport system of London is taken in Berlin by the cheaper tram, for the Berlin people are poorer than Londoners and, travelling mainly for business, average only 330 journeys per annum compared with 430 in London. This transport system has been built up by very low and unremunerative rates. The urban area already spreads for twelve miles from east to west and any further increase in area served by these lines is likely to make the losses greater.

Reichsbahn Railway Facilities in Berlin

Railway facilities provided by the Reichsbahn consist of a circle in the outskirts of the city, known as the *Ringbahn*, and two diametric lines, the *Stadtbahn*, running from west to east, and the *Nordsüdbahn* from north to south. Owing to the spread of the built-up area a considerable use is made of these lines: of the four million daily journeys made in Berlin during 1936 and 1937 the Reichsbahn handled 35%, compared with 40% for the tramways, 14% for the underground and 11% for the buses. It should be remembered that

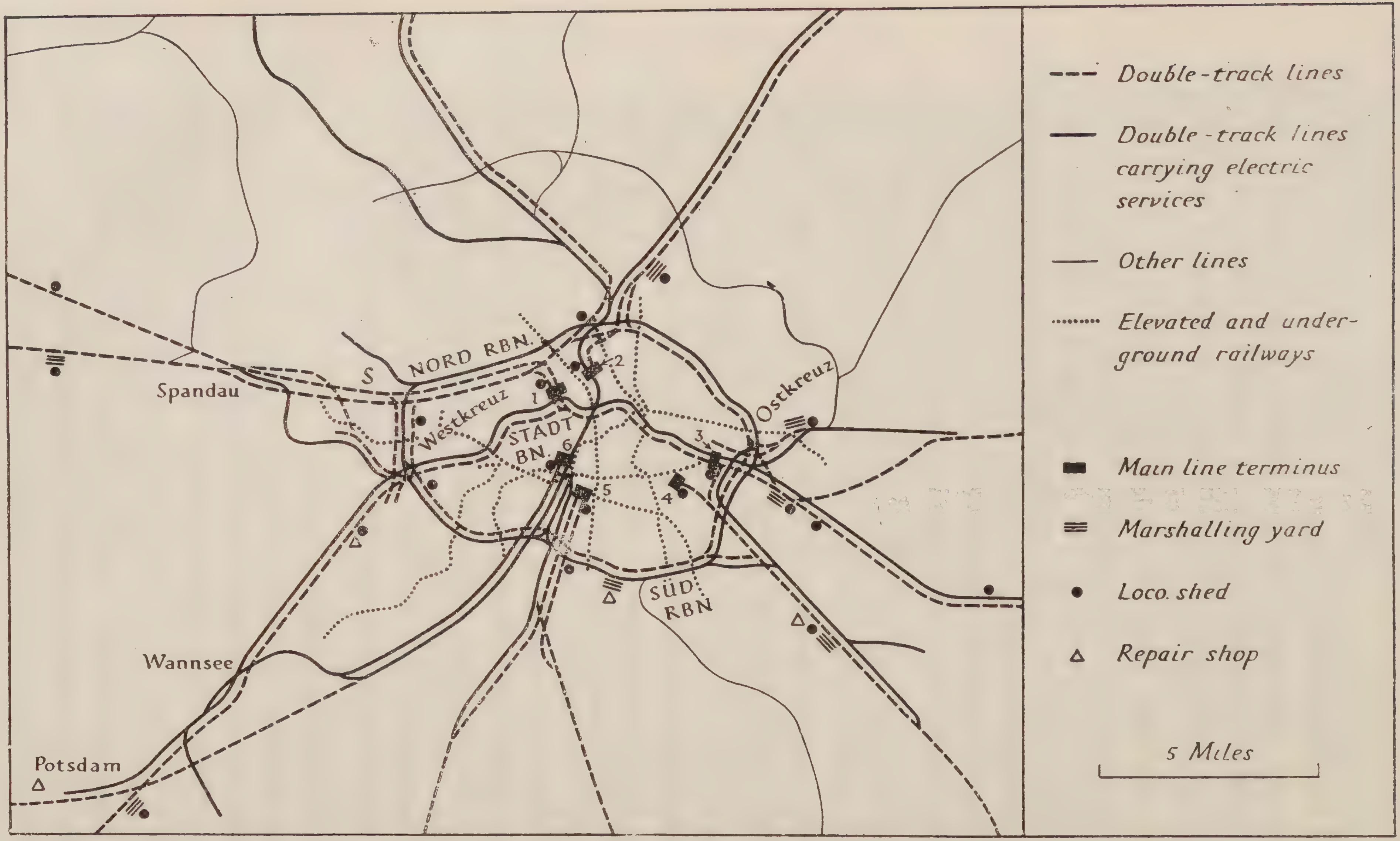

Fig. 98. The railways of Berlin

Based on G.S.G.S. Series 4416, Central Europe, 1 : 100,000, Sheets M.7, M.8, N.7, N.8, and other official sources.

S Siemenstadt. Main line stations: 1 Lehrter; 2 Stettiner; 3 Schlesischer; 4 Görlitzer; 5 Anhalter; 6 Potsdamer. The railway pattern of Greater Berlin is dominated by the radial routes, the north and south ring lines, and the cross-lines of the Stadtbahn. Marshalling yards are closer to the city on the east than on the west. As in London, the underground system fills in gaps between the main-line

owing to the greater length of journeys the value of the Reichsbahn percentage is relatively greater than that of the underground railways.

Ringbahn. The *Ringbahn*, constructed between 1867 and 1877, is a circuit of about 24 miles similar to the *Petite Ceinture* of Paris. Traffic operates to and from the Potsdamer Ring station, and is divided into northern and southern sections by the *Stadtbahn.* The line has four or more tracks throughout and is used for both passenger and freight traffic. The suburban passenger services are operated by third-rail electrification. The southern section is carried by an embankment and bridges over the quadruple main line from Potsdamer terminus over the *Nordsüdbahn* at Schöneberg, and over the lines from Anhalter passenger and goods stations at Papestrasse. Junctions with the *Stadtbahn* are made at Stralau-Rummelsburg on the east and at Halensee and Westend on the west.

Stadtbahn. The *Stadtbahn*, constructed between 1874 and 1882, comprises four tracks on a viaduct, largely of brick construction, which extends for seven miles from Charlottenburg in the west to Schlesischer Bhf. in the east. The two northerly tracks, which are used almost exclusively for passenger trains, have third-rail electrification for suburban multiple-unit trains, which call at all important stations. The electric service, even in war-time, provides a train every two minutes. The *Stadtbahn* carries about half a million passengers daily; the greatest movement, viz. about 100,000 passengers per day, occurs at the following stations: Friedrichstrasse, serving both the *Stadtbahn* and *Nordsüdbahn*, and lying a few feet below street level in the centre of the city; Alexander-Platz, which is close to the central market of Berlin and which has a special goods depot next to the passenger station; and Schlesischer-Bahnhof, adjoining the main-line station of the same name.

Nordsüdbahn. The other diametric line, *Nordsüdbahn*, is a surface line, only fully opened in October 1939, and linking the Stettiner and Anhalter stations. It crosses the Spree by means of a tunnel. This line is electrically operated for suburban traffic. At Friedrichstrasse there is an exchange station providing connexions with the *Stadtbahn.*

Siemenswerke, at Berlin-Spandau, with a personnel of 65,000 in 1928, built a line to Siemanstadt to connect with the existing railway for the convenience of the workpeople.

Operating Features. There are about 270 km. (168 miles) of electrified lines in the Berlin area. Power for the Reichsbahn electrification is obtained from Klingenberg, Golpa-Zschornewitz and Lauta-Trattendorf, with the current fed in only at two convertor-

stations (Halensee and Markgrafendamm), where the current is stepped down from 110,000 volts to 30,000 volts. The electrified routes provide frequent regular-interval services, many of which are operated right across Berlin, e.g. Erkner—Schlesischer Bahnhof—

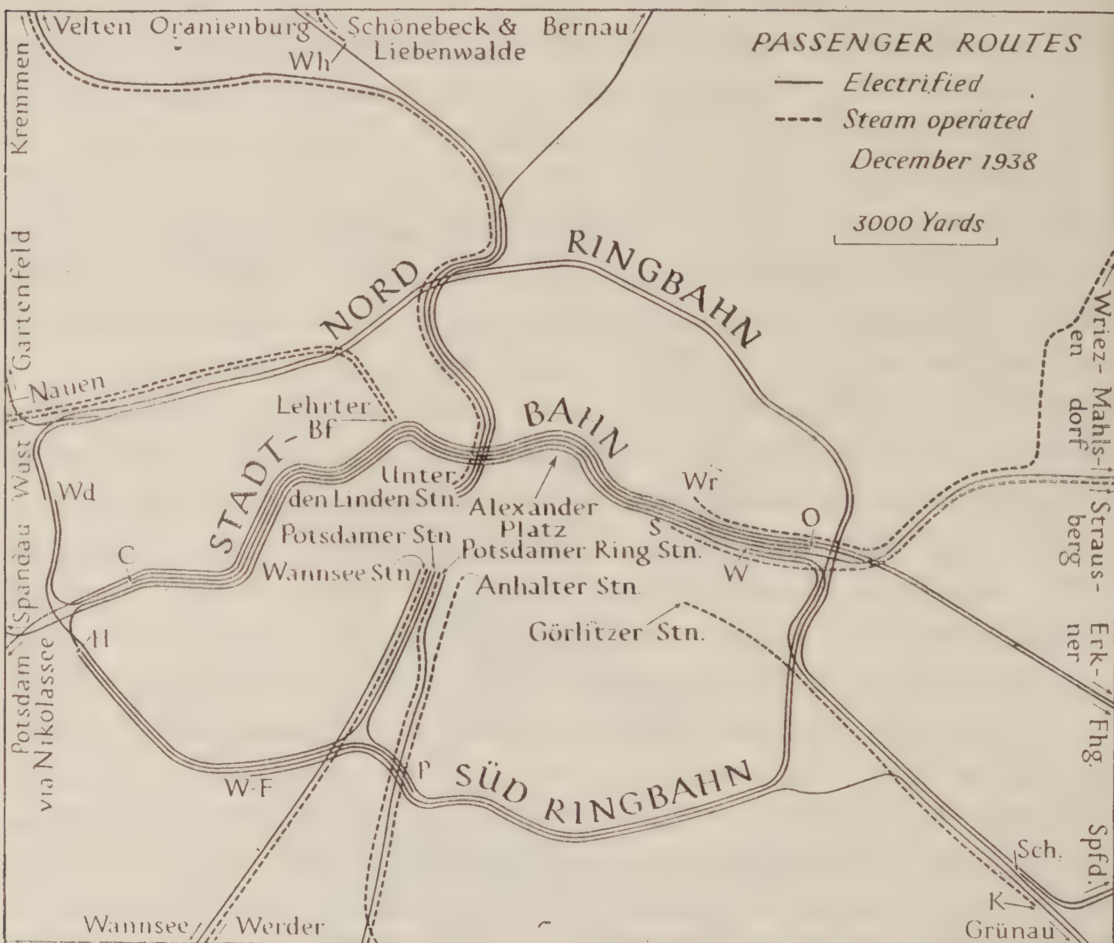

Fig. 99. Passenger routes (Reichsbahn) in Berlin

Based on data from *Reichskursbuch*, 1938.

The Reichsbahn operated many suburban services from one side of the city to the other. Each line in the diagram represents a service, e.g. from W-F (Wilmersdorf-Friedenau) to Grünau. This utilization of the Stadtbahn by five services of electric trains results in an intensive service (see p. 417). At each end the services branch out to both the Nord and Süd Ringbahn, while others run to Potsdam, Mahlsdorf, etc. C Charlottenburg; Fhg Friedrichshagen; H Halensee; K Königswusterhausen; O Ostkreuz; S Schlesischer Bf; Sch Berlin-Schönweide; Spfd Spindlersfeld; W Warschauer Strasse; Wd Westend; Wh Reinickendorf-Rosenthal; Wr Wriezener Bf.

Berlin-Charlottenburg—Potsdam (57·2 km.—35·5 miles), and so reduce to a minimum delays caused by reversing the train direction. There is a considerable interconnexion of various suburban routes, and a greater frequency of trains between about 4.30 and 1.0 a.m.

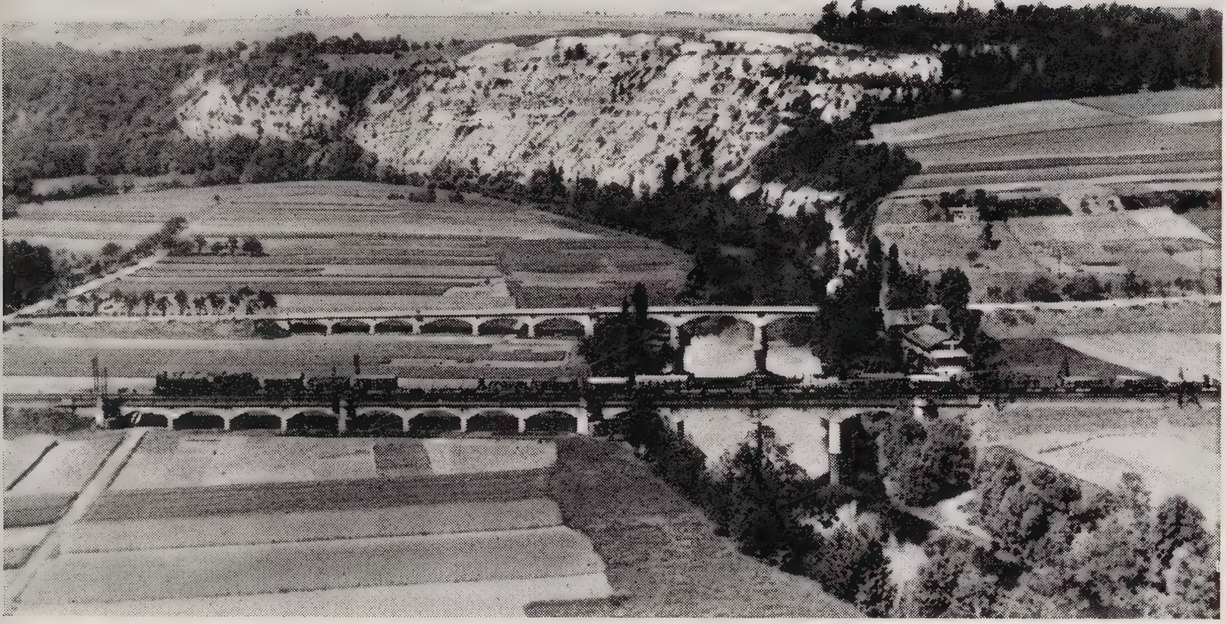

Plate 65. Saaleck: rail and road bridges over river Saale

This view is taken looking north and upstream over a meandering section of the river. The farther bridge carries a secondary road; the nearer bridge carries the double-track line from Leipzig via Weissenfels and Naumburg to Frankfurt-am-Main via Erfurt. A heavy goods traffic passes along this line. The sharp meanders of the Saale here necessitate four railway bridges in less than two miles.

Plate 66. Magdeburg: Hauptbahnhof and sidings, looking north-east

The passenger station lies in the middle distance, and the city to the right.

Plate 67. Berlin: Westkreuz suburban station

This station is also known as the Ausstellung station; it lies at the western intersection of the Stadtbahn and Ringbahn.

Plate 68. Berlin: Lehrter Bahnhof

For details of the locomotive see p. 230.

Many of the steam services run non-stop between an outer point and the terminus, e.g. between Zossen and Anhalter terminus on the Dresden—Berlin route. The *Ringbahn* services start from Potsdamer Ringbahnhof and then run both clockwise and anti-clockwise round the circular route. The *Stadtbahn*, providing the central east-west route, has the greatest intensity of traffic, to cope with which there are five trains every ten minutes in both directions. For example, in every ten minutes, starting from the even hour, the following trains stopped at Berlin-Charlottenburg in 1938.

To	Westbound	Eastbound	To
Südring-Grunewald	2	1	Berlin-Friedrichshagen
Nordring	4	3	Lichtenberg-Friedrichsfelde, Berlin-Mahlsdorf
Spandau-West	6	6	Erkner
Reverses to Eastbound	7	8	Nordring
Grunewald-Potsdam	9	9	Berlin-Grünau

Railway repair shops are situated at Ostbahnhof (rolling stock), Grunewald (wagons), Tempelhof (locomotives and coaches), Schöneweide (electric locomotives and rolling stock), Potsdam (coaches), and Brandenburg West (locomotives).

Main Line Railways

The principal passenger termini for long-distance traffic are Anhalter station (for central and south Germany, Switzerland, Italy and Czechoslovakia), Potsdamer (for Köln and Magdeburg), Görlitzer (for south-east Germany), Lehrter (for west and north-west Germany, Holland and Belgium) Stettiner (for the Baltic coast and Stettin), and Schlesischer (East Prussia, Poland, Silesia and Czechoslovakia).

Freight traffic from the south is handled at goods depots near the Potsdamer and Anhalter termini while the rest of the freight movement is dealt with on the *Ringbahn*, including the Lehrter terminus.

Berlin Main Stations

	South of R. Spree	North of R. Spree
Passenger:	Anhalter Potsdamer Görlitzer	Lehrter Schlesischer Stettiner
Goods:	Anhalter Potsdamer Charlottenburg Berlin-Spandau Görlitzer	Lehrter Schlesischer Stettiner

For handling freight leaving and entering the city there are seven key marshalling yards outside the *Ringbahn* (Fig. 98) with full modern equipment. These yards are each capable of handling at least 2,400 wagons every 24 hours. Transit stations for transhipping goods

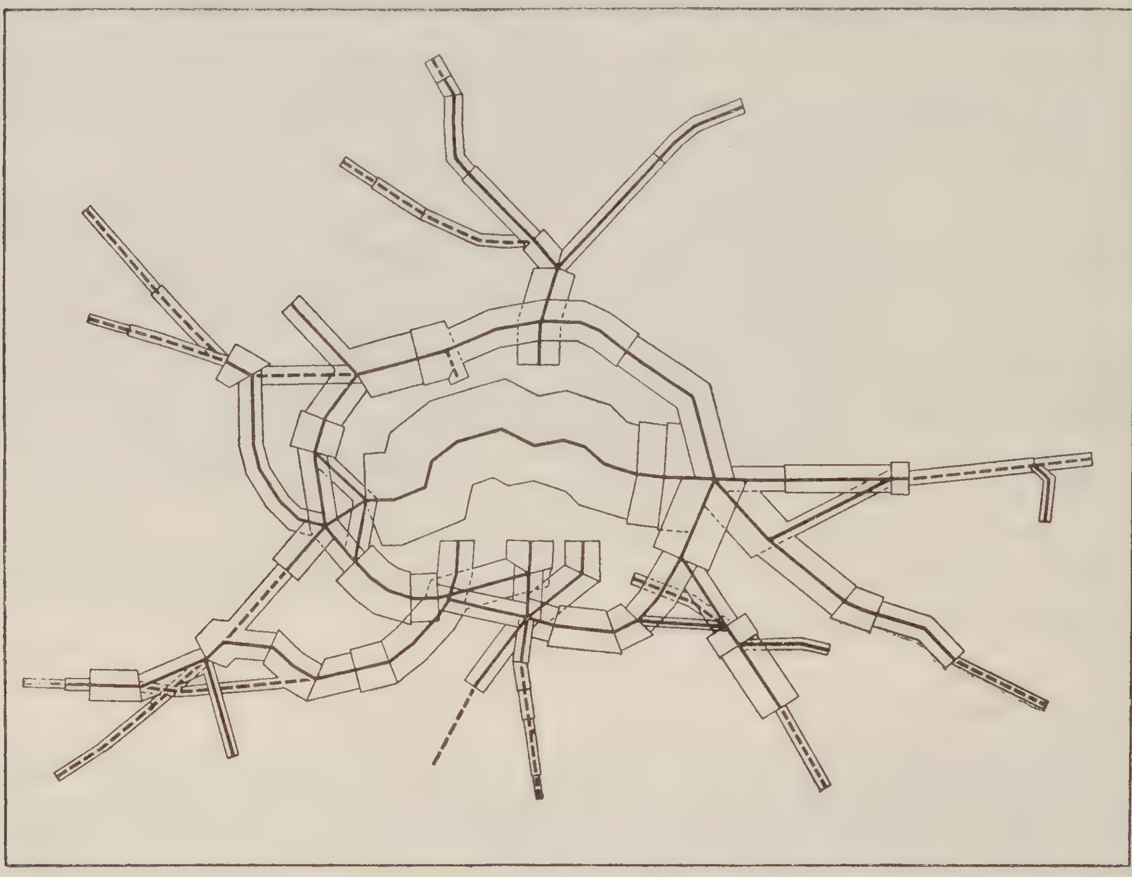

Fig. 100. Suburban traffic flow in Berlin on 16 November, 1931 (Reichsbahn lines)

Based on traffic load charts of the Berlin Railway Administration, from *Zentralblatt der Bauverwaltung*, 53rd year (Berlin, 1.3.1933).

The continuous thick lines show the electrified services at that date. The distance between the parallel fine lines on any stretch is proportional to the magnitude of the traffic. The importance of the *Stadtbahn*, running through the centre of the city from east to west, is clear enough. The passenger flow as a whole takes up a strikingly symmetrical form—the radiating feeder lines to the outer suburbs and satellite towns, the heavy traffic along the circumferential *Ringbahn*, and the very heavy traffic along the diametrical *Stadtbahn*.

in the Berlin area are situated at Berlin Anhalter (goods), Seddin, Pankow, Wustermarck (goods) and Rummelsburg.

Goods Traffic. The statistics which illustrate the traffic of the Berlin region relate to the Berlin and Brandenburg traffic districts, Nos. 16 and 17 (see p. 280).

Traffic, 1936 (*in thousands of tons*)

District	Local	Loaded to	Unloaded from	Loaded to	Unloaded from
		other German districts		foreign countries	
Berlin	961	3,295	11,337	57	271
Brandenburg	5,111	9,335	10,933	22	88

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1936*, Heft I, II, *passim.*

As the table shows, there is a very unbalanced traffic for Berlin and a nearly balanced traffic for Brandenburg. The much smaller area of the Berlin district and the greater weight of goods unloaded emphasizes the intensity of the local traffic from the capital. Of the goods sent out from Berlin, the bulk commodities are limited in range; the biggest of these is 'other fertilizers' (636,500 tons), which goes into the neighbouring district of Brandenburg. The imports of Berlin are far more varied. Solid fuel from all the coalfields forms the greatest item, followed by worked and artificial stone from the uplands, potatoes from the North German Plain, fish from Hamburg, and building materials (timber and sand from the North German Plain, and cement from the central industrial area are important entries). The direct rail imports from abroad are principally foodstuffs, including eggs and milk products from Denmark and fruit from south-eastern Europe and Italy.

Brandenburg has more varied bulk exports, with lignite briquettes as the largest item. There is a heavy outward movement to the Saxony district which takes potatoes, lignite, sand and timber principally in exchange for worked stone. The main 'imports' of the district are coal, fertilizers and cement. Brandenburg carries on little direct rail traffic with foreign countries. (See tables on page 420.)

Details of the larger commodity movements show that traffic into and out of Berlin is typical of the traffic of a great city. The movement of a multitude of small consignments in both directions does not appear at all, for traffic is dominated by the inward flow of fuel, stone, metals, etc. (in which the waterways, it must be remembered, play a considerable part).

Goods Traffic of Berlin and Brandenburg, 1936 (*by traffic districts to or from which commodity items of* 50,000 *tons or more were despatched or received, in thousands of tons*)

Berlin (*District No.* 16)

	Outwards from No. 16	Inwards to No. 16
Pomerania	—	Potatoes (84·4)
Hanover, Hildesheim	—	Iron and steel (59·3)
Upper Silesia	—	Coal (783·2), coke (50·9)
Lower Silesia	—	Coal (193·2), coke (67·0), worked stone (246·3), artificial stone (67·7)
Brandenburg	Sand (286·1), 'other' fertilizers (636·5), scrap iron (186·5)	Potatoes (61·1), lignite (1,789·1), sand (188·0), cement (240·8), timber (146·5), artificial stone (261·9), sheet metal and tinplate (70·1), removals (57·9)
Merseburg, Erfurt	—	Lignite (360·4), sand (149·1)
Saxony	—	Worked stone (332·0), paper, pulp (95·0)
Westphalian Ruhr	—	Coal, (532·7), coal briquettes (56·7), coke (288·0), iron and steel (70·6)
Rhine prov. Ruhr	—	Coal (217·2), coal briquettes (40·1)
Westphalia	—	Coal (51·8), cement (77·5)

Brandenburg (*District No.* 17)

	Outwards from No. 17	Inwards to No. 17
E. Prussia	Lignite (117·8)	—
Pomerania	Lignite (282·7), sand (120·0)	Sugar beet (51·8)
Pomeranian ports	Lignite (366·3)	—
Mecklenburg	Lignite (184·4)	—
W. Baltic ports	Lignite (99·3)	—
Schleswig-Holstein	Lignite (171·0)	—
Elbe ports	Lignite (64·9)	—
Hanover, Hildesheim	—	Lignite (72·3)
West Prussia	Lignite (61·3), sand (86·7)	Sand (83·1)
Upper Silesia	—	Coal (812·7), coke (61·8), cement (94·3)
Lower Silesia	Lignite (184·8)	Coal (231·1), coke (53·3), lignite (216·1), worked stone (822·8), limestone (76·7), other minerals (76·7), artificial stone (79·7)
Berlin	See table above under 'Brandenburg, inwards'	See table above, under 'Brandenburg, outwards'
Magdeburg, Anhalt	—	Worked stone (84·5), sand (86·1), potash fertilizers (151·4)
Merseburg, Erfurt	—	Lignite (436·4), sand (63·8), potash fertilizers (85·7), nitrogen fertilizers (147·1)
Saxony	Lignite (721·0), removals (57·9)	Worked stone (1,371·0)
Westphalian Ruhr	Pitprops (116·6)	Coal (313·9), coke (105·9), basic slag (79·8)

From: *Die Güterbewegung auf deutschen Eisenbahnen, 1936*, Heft I II, *passim* (Berlin, 1937).

War-time Conditions, 1939–44

The progress of the war since 1939 placed an inevitable strain upon the Reichsbahn, a strain which was to increase owing to variations in the flow of traffic as the war passed through its phases, the growing shortage of labour, and the cumulative effects of air attacks.

Organisation and Operation

During the war, government control of the railways tightened, as with other forms of transport. A number of the remaining private railways were nationalized. The Reichsbahn entered into forms of co-operation with road and waterway transport agencies in order to co-ordinate their activities and to employ carrying capacity to the best advantage. Under a central traffic office three area traffic offices functioned (at Berlin, Essen, and Munich), with a number of subsidiary offices. There was, however, no fundamental change in the status or internal organization of the Reichsbahn.

In the occupied territories the general policy was to incorporate into the Reichsbahn only the railways in territories incorporated into the Reich, e.g. the railways of Luxembourg and Lorraine were incorporated into those of the Saarbrücken R.B.D. and those of Alsace into the Karlsruhe R.B.D. For a time the lines in the Channel coast zone in France were operated by the Germans themselves. In the General Government area of Poland the railways were operated by a virtual subsidiary of the Reichsbahn, known as the *Ostbahn*. In occupied Russia a special organization for railway operation was established, the *Haupteisenbahndirektion*. In all other parts of occupied Europe the Germans did not themselves take over the operation of the railways. Each individual administration operated its lines, under German control and with German directives, subject to the proviso that German requirements had absolute priority.

The staff problem became acute, for at a time when the demands for and upon staff in Germany itself were heaviest, the Reichsbahn had to meet problems like the call-up of younger men into the armed forces, the drafting of some of its members into the various corps of railway troops, and the supply of operating staffs for the railways in Russia. The shortage was countered by such measures as the working of considerable overtime, employment of women, recall of retired staff, and employment of foreign workers. Foreigners were even employed as engine-drivers. In the autumn of 1943, it is estimated, the total numbers employed on railway work, both inside and outside the Reich, amounted to between 1,200,000 and 1,500,000.

At the outbreak of war all diesel railcar services were suspended in order to conserve supplies of fuel and lubricants. Railway electrification has developed since 1939, in that the electrification of the section from Nuremberg to Weissenfels via Saalfeld has been completed. It seems probable that current consumption has increased owing both to the completion of this line and to the diversion to the electrified sections of as much traffic as possible in order to ease the steam locomotive position. Through a combination of factors the general locomotive position probably reached its most critical passage in the winter of 1941–2. It is thought that by the autumn of 1943 new production had outstripped losses. A number of war-time locomotive types were produced by the Reichsbahn, including a special design for operating in occupied Russia and an austerity type. The latter was introduced to save materials: it was claimed that 25 tons of steel were saved and that non-ferrous metal consumption was greatly reduced in the construction of each *Kriegslokomotive.* The weight of this locomotive, in working order, was 85·7 tons and the axle-loading 15·3 tons; its maximum speed was 50 m.p.h.

Damage by air attack added to the difficulties of railway operation. The large number of alternative routes available, and the many marshalling yards in use, reduced the more immediate effects of raids. Indirect, as well as direct effects, however, combined to throw a considerable burden on the system: the necessary diversion of trains over routes and through yards not suited to heavier traffic, and the necessity of operating traffic arising through the evacuation of civilians, the evacuation of factories, and the establishment of factories in 'safer' areas, where railway facilities were not always adequate.

Railway Traffic

Goods. The volume of goods carried by rail increased as the war developed: between 1938 and 1941 the increase amounted to 76% (the figure for total goods traffic in 1938 was 520 million tons, an increase of about 4% on the 1937 figure of 499 million tons). The greater magnitude of goods was not in itself the most serious problem: the difficulty lay in the necessity of carrying this tonnage under war-time conditions—shortage of labour, black-out, working of military priorities, and the frequent necessity for re-routing. At first various forms of encouragement were given to traders to utilize the waterways as far as possible: cheap rates and joint rail-water rates were offered, for example. In 1941 several R.B.D. went so far as to announce that no goods would be accepted for carriage on

routes over which carriage by water was possible, except for urgent traffic and perishable goods. A system of priorities also helped to restrict the volume of traffic. By a decree of 1942 the government assumed powers for regulating the volume and flow of traffic and for restricting the amount of cross-haulage.

A wagon pool was established, and the use of wagons controlled. Users were allowed shorter periods for unloading. Large numbers of wagons were taken from the occupied countries. Overloading of wagons became necessary, by an amount which varied through the course of the war but which was usually 2 tons.

Passenger Traffic

Pressure on goods transport was eased by a reduction of passenger facilities. Until the winter of 1939–40 this reduction was not very great, but since then considerable further reductions were made. Only about half the number of pre-war passenger trains were in service; very fast trains were suspended; as a result more frequent stops were necessary by the trains in operation. Special fares were abolished and the public was encouraged in various ways to travel less. There is little doubt, however, that passenger traffic has been much heavier than before the war.

Tables

The following three tables summarize much of the detail of the history of the German railways. They show (i) the principal companies, state and private, operating in 1866; (ii) the date of completion of the principal lines; (iii) the length of line, by states, in 1880.

I. *Principal German Railway Companies in* 1866

Rhine Valley

Bergisch-Märckische Eisenbahn
Maximiliansbahn
Taunus Eisenbahn
Königliche Saarbrücken, Saarbrücker, Trier, Luxemburger, Rheine Nahe, Eisenbahn
Rhenische Eisenbahn
Köln-Mindener Eisenbahn
Aachen, Düsseldorf, Ruhrorter Eisenbahn
Main-Neckar Eisenbahn
Herzögliche Nassauische Staats-Eisenbahn, (*a*) Rheinbahn, (*b*) Lahnbahn
Hessische Ludwigs Eisenbahn
Neustadt-Ludwigshafen-Mainz Eisenbahn
Köln-Giessener Eisenbahn
Westphälische Eisenbahn
Wiesenthalbahn
Main-Weser Eisenbahn
Königlich Bayer Pfälzische Eisenbahn
Grossherzöglich Badische Staats-Eisenbahn

Other Districts

Königliche Wurttembergische Staats Eisenbahn
Breslau-Schweidnitz Freiburger Eisenbahn
Königlich Bayer Staats Eisenbahn
Tilsit Insterburger Eisenbahn
Ost Preussisere Südbahn
Thuringischen Eisenbahn
Königliche Ostbahn
Kurfurst Friedrich Wilhelms-Nordbahn
Berlin-Stettiner Eisenbahn
Werra Eisenbahn
Berlin-Anhältische Eisenbahn
Neubrandenburg-Gustrow Eisenbahn
Mecklenbergische Eisenbahn
Lübeck, Hamburger Eisenbahn
Königlich Niederschlesische Maerkische Eisenbahn
Magdeburg-Halberstadter Eisenbahn
Oberschlesischen Eisenbahn
Königliche-Hannoversche Eisenbahn
Königlich Niederschlesisch Markische Eisenbahn
Westphälische Eisenbahn
Neisse-Brieger Eisenbahn
Königliche Sachsische Westliche Staatseisenbahn
Leipzig-Dresdner Eisenbahn
Unterer Neckar und Kocherbahn
Frankfurt Hanaver Eisenbahn

II. *German railway construction, by date of completion of principal lines*

(*i*) 1835–1839 *The Earliest Railways*

Date	Section	
1835	Nuremberg—Fürth	The *Ludwigsbahn:* first German railway
1837	Leipzig—Alten	First section of List's line and first Saxon railway
1838	Potsdam—Zehlendorf	First Prussian railway
1838	Berlin—Potsdam	
1838	Brunswick—Wolfenbüttel	First German state railway
1838	Düsseldorf—Erkrath	First line in western Germany
1839	Leipzig—Dresden	First tunnel (Oberau)
1839	Magdeburg—Schönebeck	
1839	Köln—Müngersdorf	
1839	Munich—Lochhausen	
1839	Frankfurt-am-Main—Höchst	

(*ii*) 1840–1860. *Trunk Line Construction*

1840	Frankfurt-am-Main—Wiesbaden	
1840	Magdeburg—Halle	
1840	Halle—Leipzig	
1840	Köthen—Dessau	
1840	Mannheim—Heidelberg	First Baden line
1840	Munich—Augsburg	

1841	Berlin—Jüterbog	
1841	Köln—Aachen	
1841	Düsseldorf—Elberfeld	
1841	Jüterbog—Wittenberg	(Joining Berlin, Köthen, Halle, Leipzig, Dresden)
1842	Breslau—Ohlau	First Silesian line
1842	Leipzig—Altenburg	
1842	Berlin—Frankfort-an-der-Oder	
1843	Heidelberg—Karlsruhe	
1843	Breslau—Oppeln	
1843	Magdeburg—Oschersleben—Halberstadt	
1843	Berlin—Köthen—Magdeburg—Brunswick	
1843	Berlin—Stettin	
1843	Köln—Herbesthal	First connexion with Belgium
1843	Brunswick—Harzburg	
1844	Köln—Bonn	
1844	Brunswick—Hanover	
1844	Karlsruhe—Offenburg	
1844	Nuremberg—Bamberg	Second Bavarian line
1844	Altona—Kiel	
1844	Breslau—Liegnitz	
1845	Offenburg—Freiburg	(Joining Heidelberg, Karlsruhe, Freiburg)
1845	Hanover—Celle	
1845	Cannstatt—Untertürkheim	First Württemberg line
1845	Dresden—Radeberg	
1845	Deutz—Düsseldorf	
Total length of line 1845, 2,300 km.		
1846	Düsseldorf—Duisburg	
1846	Bamberg—Lichtenfels	
1846	Augsburg—Donauwörth	
1846	Halle—Weissenfels	
1846	Langen—Heppenheim	
1846	Bischofswerda—Bautzen	(Joining Dresden, Bautzen)
1846	Hanover—Hildesheim	
1846	Dresden—Pirna	
1846	Potsdam—Magdeburg	(Joining Berlin, Magdeburg)
1846	Frankfurt-an-der-Oder—Bunzlau	(Joining Berlin, Breslau)
1846	Boizenburg—Bergdorf	(Joining Berlin, Hamburg)
1846	Weimar—Weissenfels	First Thuringian line
1847	Weimar—Erfurt	(Joining Halle, Erfurt)
1847	Celle—Harburg	(Joining Hanover, Harburg)
1847	Duisburg—Dortmund—Hamm	
1847	Neustadt—Ludwigshafen	
1847	Schifferstadt—Speyer	
1847	Gotha—Eisenach	(Joining Halle, Weimar, Erfurt, Gotha, Eisenach)
1847	Reichenbach—Gorlitz	(Joining Dresden, Breslau)
1847	Elberfeld—Schwelm	
1847	Hanover—Minden—Hamm	(Joining Köln, Hanover, Magdeburg, Berlin)

1847	Wunstorf—Bremen	(Joining Hanover, Bremen)
1848	Grebenstein—Hümme—Harleshafen	
1848	Münster—Hamm	
1848	Stettin—Kreuz	
1848	Schwerin—Wismar	
1848	Frankfurt-am-Main—Hanau	
1848	Herzberg—Röderau	(Joining Berlin, Dresden)
1848	Plauen—Hof	(Joining Nuremberg, Plauen)
1848	Elberfeld—Dortmund	
1849	Magdeburg—Wittenberg	
1849	Neustadt—Neidenfels	(Joining Ludwigshafen, Kaiserslautern, Bexbach)
1849	Bebra—Gerstungen—Eisenach	(Joining Halle, Erfurt, Kassel)
1849	Gunzenhausen—Pleinfeld—Schwabach	(Joining Munich, Nuremberg)
1849	Sachsenhausen—Frankfurt-am-Main	(Joining Heidelberg, Frankfurt)
1849	Kassel—Wabern	
1850	Kirchhain—Marburg (Lahn)	(Joining Kassel, Marburg)
1850	Bad Kleinen—Rostock—Bützow—Güstrow	
1850	Ulm—Biberach	(Joining Ulm, Friedrichshafen)
1850	Geislingen—Ulm	(Joining Stuttgart, Ulm)
1850	Hamm—Paderborn	
1850	Bexbach—Neunkirchen	First Prussian state line
1851	Dresden—Bodenbach	
1851	Reichenbach—Plauen	
1851	Kreuz—Bromberg	
1851	Berlin—Ringbahn	(Stettiner Bahnhof, Brandenburger Tor, Königgrätzer Strasse, Stalitzer Strasse, Schlesischer Güterbahnhof)
1851	Lübeck—Büchen	
1852	Altstadt—Neustadt	
1852	Frankfurt-am-Main—Giessen—Marburg—Kassel	(Joining Berlin, Halle, Erfurt, Kassel, Frankfurt, Giessen
1852	Bromberg—Dirschau	(Joining Stettin, Kreuz, Danzig)
1852	Marienburg—Braunsberg	First railway to E. Prussia
1852	Neuenkirchen—Forbach	First railway to France
1853	Mainz—Oppenheim	
1853	Paderborn—Warburg	(Joining Hamm, Kassel)
1853	Braunsberg—Königsberg—Braunsberg—Marienburg—Danzig	(Joining Berlin, Königsberg)
1853	Bietigheim—Bruchsal	
1853	Oberstaufen—Lindau	(Joining Munich, Augsburg, Lindau)
1853	Ludwigshafen—Worms	
1854	Augsburg—Ulm	(Joining Stuttgart, Munich)
1854	Würzburg—Aschaffenburg	(Joining Bamberg, Aschaffenburg)
1854	Aachen—Gladbach—Düsseldorf	
1854	Flensburg—Rendsburg	
1855	Haltingen—Basel	(Joining Frankfurt, Mannheim, Basel)
1855	Dortmund—Soest	

1855	Neustadt—Landau	
1855	Köln—Neuss	
Total Length of line 1855, 8,500 *km.*		
1856	Köln—Krefeld	
1856	Münster—Rheine—Osnabrück	(Joining Münster, Emden)
1856	Minden—Kassel	(Joining Hanover, Kassel)
1856	Dinslaken—Emmerich	First line to the Netherlands
1856	Breslau—Posen	(Joining Breslau, Stettin)
1857	Berlin—Frankfurt-an-der-Oder—Küstrin	
1858	Bingerbrück—Bad Kreuznach	
1858	Mainz—Darmstadt	
1858	Rosenheim—Tirol (Austrian frontier)	
1858	Munich—Landshut	
1858	Weisenthurm—Koblenz Köln—Koblenz	
1858	Chemnitz—Zwickau	
1858	Darmstadt—Aschaffenburg	(Joining Darmstadt, Würzburg, Bamberg)
1859	Eisenach—Coburg—Lichtenfels	
1859	Bitterfeld—Halle	
1859	Bitterfeld—Leipzig	
1859	Berlin—Leipzig	
1859	Köln—Deutz	
1859	Mainz—Bingen	
1859	Hersbruck—Regensburg	(Joining Regensburg, Nuremberg)
1859	Koblenz—Bingerbrück	(Joining Köln, Mainz)
1860	Trier—Saarbrücken	
1860	Bingerbrück—Neuenkirchen	
1860	Traunstein-frontier	(Joining Munich, Salzburg, Vienna)
1860	Stallupönen—frontier	First railway to Russia

(*iii*) 1861–1875 *Construction of other main lines*

1861	Hagen—Altena—Siegen	
1861	Munich—Passau	
1862	Köln—Giessen	
1862	Rüdesheim—Oberlahnstein	
1862	Halberstadt—Quedlinburg—Thale	
1862	Witten—Dortmund—Bochum Essen—Mülheim—Duisburg—Oberhausen	
1863	Frankfurt-am-Main—Mainz	
1863	Oberlahnstein—Wetzlar	
1863	Bremen—Bremerhaven	
1863	Memmingen—Kempten	(Joining Ulm, Lindau)
1863	Pforzheim—Mühlacker	(Joining Karlsruhe, Stuttgart)
1863	Waldshut—Konstanz	(Joining Basel, Konstanz)
1863	Cannstatt—Nördlingen	
1863	Anklam—Stralsund	
1865	Insterburg—Tilsit	
1865	Nuremberg—Fürth—(Rottendorf—Würzburg	

1865	Lübeck—Oldesloe—Wandsbek—Hamburg	
1865	Pillau—Königsberg	

Total length of line 1865, 14,200 *km.*

1866	Bebra—Hersfeld	
1866	Offenburg—Hausach	
1866	Heidelberg—Würzburg	(Joining Nuremberg, Heidelberg)
1867	Neubrandenburg—Strasburg	(Joining Schwerin, Stettin)
1867	Oldenburg—Bremen	
1867	Kohlfurt — Hirschberg — Waldenburg	
1867	Oldenburg—Wilhelmshaven	
1867	Berlin—Gusow	
1867	Berlin—Küstrin	
1867	Munich—Ingolstadt	
1868	Königsberg—Lyck	
1869	Plochingen—Villingen	
1869	Bietigheim—Jagstfeld	
1870	Ingolstadt—Treuchtlingen	
1870	Tuttlingen—Immendingen	(Joining Stuttgart, Singen)
1870	Stolp—Lauenburg—Zoppot	(Joining Stettin, Danzig)
1871	Oberlahnstein—Troisdorf	
1871	Berlin—Spandau	
1871	Gerolstein—Trier	(Joining Köln, Trier)
1871	Giessen—Fulda	
1871	Münster—Osnabrück	
1871	Gardelegen—Lehrte	(Joining Berlin, Lehrte, Hanover)
1872	Arenshausen—Minden—Hanover	(Joining Halle, Eisleben, Nordhausen)
1872	Harburg—Hamburg	
1872	Steinheim—Altenbeken	(Joining Hanover, Hameln, Altenbeken)
1873	Bestwig—Warburg	(Joining Schwete, Arnsberg, Bestwig, Warburg)
1873	Uelzen—Langwedel	(Joining Berlin, Bremen)
1873	Regensburg—Nuremberg	
1873	Neumarkt—Seubersdorf	
1873	Ulm—Sigmaringen	
1873	Rühr—Münster	
1873	Hemelingen—Bremen	
1873	Schneidemühl—Konitz—Dirschau	
1873	Hausach—Villingen	First mountain line
1873	Offenbach—Singen	
1873	Frankfurt—Offenbach—Hanau	(Joining Frankfurt, Bebra)
1874	Ingolstadt—Regensburg	
1874	Bremen—Harburg	
1875	Ansbach—Crailsheim	(Joining Nuremberg, Ansbach, Heilbronn)
1875	Berlin—Dresden	
1875	Dresden—Chemnitz	

Total length of line 1875, 27,900 km.

(*iv*) *Branch line construction*, 1876–1919

1876	Neiderhone—Friedland	
1876	Weimar—Jena—Gera	

1877	Berlin—Neubrandenburg	
1877	Tempelhof—Charlottenburg—Moabit	(Ringbahn)
1878	Demmin—Stralsund	(Joining Berlin, Stralsund)
1879	Charlottenburg—Grünewald—Blankenheim	
1879	Koblenz—Ehrang	Kochem tunnels opened
1881	Kirchberg—Wilkau	First narrow-gauge line (Saxony)
1881	Himmelpforten—Cuxhaven	(Joining Hamburg, Cuxhaven)
1882	Munich—Starnberg	First electrified line
1882	Spandau—Charlottenburg	
1883	Stralsund—Bergen (Rügen)	

Total length of line 1885, 37,600 km.

1886 Warnemünde—Neustrelitz
1887 Freiburg—Titisee—Neustadt
1888 Dresden—Elsterwerda
1891 Bergen (Rügen)—Sassnitzhafen
1894 Blankenese—Hasselbrook
1895 Tettnang—Meckenbeuren electrification

Total length of line 1895, 46,500 km.

1900 Wannseebahnhof (Zehlendorf) electrification
1903 Potsdam Ringbahnof—Lichterfeld electrification
1903 Marienfelde—Zossen electrification
1904 Murnau—Oberammergau electrification

Total length of line 1905, 56,900 *km.*

1906 Karlsruhe—Maxau
1906 Donauwörth—Treuchtlingen
1907 Hamburg—Altona electrification
1908 Berchtesgaden—Schellenberg—frontier electrification
1908 Blankenese—Ohlsdorf electrification
1908 Salzburg—Bad Reichenbach—Berchtesgaden electrification
Garmisch-Partenkirschen—Mittenwald—frontier electrification
Saarlachtrastwerkes—Bad Reichenbach electrification
1909 Berchtesgaden—Königssee
1909 Sassnitz—Trälleborg train-ferry put in operation
1909 Wunstorf—Hanover Linden—Misburg
1910 Garmisch-Partenkirchen electrification
1911 Bitterfeld-Dessau electrification
1912 Garmisch-Partenkirchen—frontier electrification
1914 Nieder Salzbrunn, Halbstadt—Bad Salzbrunn electrification
1915 Gottesberg—Fellhammer

Total length of line 1915, 62,400 *km.*

1916 Freiburg (Schl)—Nieder Salzbrunn—Gottesberg electrification
1916 Klingenthal—Sachsenberg—Georgenthal electrification
1916 Salzburg—Freilassing—Bad Reichenhall electrification
1917 Königszelt—Freiburg electrification
1921 Ruhbank—Landshut—Liebau electrification
1922 Zerbst—Bitterfeld—Leipzig—Halle
1923 Magdeburg—Zerbst electrification
1924 Ohlsdorf—Poppenbüttel electrification
1924 Berlin—Bernau electrification
1925 Munich—Garmisch-Partenkirchen electrification
1925 Elberfeld — Vohwinkel — Mettmann — Wulfrath — Velbert — Langenburg goods line

1925 Munich—Landshut electrification

Total length of line 1925, 57,800 *km.*

1927 Oberuhldingen—Mühlofen—Meersburg—Immenstadt—Fischbach goods line

1927 Munich—Rosenheim electrification

1927 Neufahrn—Regensburg electrification
Munich—Regensburg electrification

1927 Rosenheim—Kufstein electrification

1927 Nuremberg—Fürth electrification

1928 Breslau—Königszelt electrification

1928 Rosenheim—Traunstein electrification

1928 Lauban—Kohlfurt electrification

1928 Munich—Salzburg electrification

1928 Potsdam—Erkner electrification

1928 Lauban—Marklissa electrification

1928 Wannsee—Stahnsdorf electrification

1928 Charlottenburg—Südring—Grünau—Stralau—Rummelsburg—Grünau—Schlesischer Bhf—Kaulsdorf electrification

1929 Ringbahn (Berlin) electrification

1931 Kannhofen—Augsburg electrification

1933 Ludwigsburg—Stuttgart—Esslingen electrification

1933 Augsburg—Ulm—Stuttgart electrification

1934 Halle—Köthen—Magdeburg electrification

1935 Augsburg—Nuremberg electrification

Total length of line 1935, 58,370 *km.*

From : *Hundert Jahre Deutsche Eisenbahnen*, pp. 503–20 (Berlin, 1935).

III. *Length of railways (in km.), by states, in 1880; (i) Main lines (Hauptbahnen)*

State	State railways		Private railways, State operated		Private railways		Total	No. of private companies
	Double track	Total	Double track	Total	Double track	Total		
Prussia	4,770·55	10,134·47	984·91	3,313·49	1,097·45	4,835·06	18,283·02	29
Bavaria	268·06	3,841·15	—	—	192·61	599·30	4,440·45	2
Saxony	808·11	1,820·84	—	26·61	—	—	1,847·45	1
Württemberg	169·50	1,487·52	—	—	—	16·70	1,504·22	2
Baden	407·58	1,100·88	—	57·65	—	—	1,158·53	1
Hesse	49·66	225·43	—	—	—	—	225·43	—
Oldenburg	—	260·66	—	—	—	33·00	293·66	1
Meiningen	—	20·27	—	—	—	170·83	191·10	1
Sch.-Lippe	24·33	24·33	—	—	—	—	24·33	—
Bremen	—	104·89	—	—	—	—	104·89	—
Hamburg	18·96	18·96	—	—	—	—	18·96	—
Alsace-Lorraine	526·08	992·41	—	84·54	—	11·00	1,087·95	2
Hessen	—	—	—	—	228·66	605·13	605·13	1
Mecklenburg-Schwerin	—	—	—	—	—	326·57	326·57	1
Weimar	—	—	—	—	—	176·67	176·67	3
Brunswick	—	—	—	—	278·60	339·54	339·54	1
Coburg-Gotha	—	—	—	—	—	17·30	17·30	1
Total	7,041·83	20,031·81	984·91	3,482·29	1,797·72	7,131·10	30,645·20	46

Total of double track, 9,825·46 km.

From: *Übersichts-Karte der Eisenbahnen Deutschlands* (Berlin, 1880).

III. *Length of railways (in km.), by states, in 1880; (ii) Branch lines (Nebenbahnen)*

State	State railways		Private railways, State operated		Private railways		Total	No. of private companies
	Normal gauge	Narrow gauge	Normal gauge	Narrow gauge	Normal gauge	Narrow gauge		
Prussia	1,506·76	00·40	255·45	59·11	545·37	30·80	2,397·89	26
Bavaria	328·43	—	—	—	26·21	—	354·64	1
Baden	107·06	—	—	—	—	—	107·06	—
Weimar	—	33·00	—	—	—	—	33·00	—
Oldenburg	18·05	—	—	6·75	—	—	24·80	1
Coburg-Gotha	9·10	—	—	—	—	—	9·10	—
Alsace-Lorraine	65·58	—	2·90	—	37·43	8·00	113·91	2
Saxony	179·65	—	63·25	—	—	—	243·90	1
Mecklenburg-Schwerin	—	—	—	—	28·38	—	28·38	1
Brunswick	—	—	—	—	26·50	—	26·50	2
Altenburg	—	—	—	—	8·60	—	8·60	1
Total	2,214·63	33·40	321·60	65·86	672·49	38·80	3,346·78	35

Total of normal gauge, 3,208·72.

From: *Übersichts-Karte der Eisenbahnen Deutschlands* (Berlin, 1880).

Plate 69. The Goltzschtal viaduct between Reichenbach and Plauen
This structure is 240 ft. high (see p. 378).

Plate 70. Stettin: railway bridge across the Oder

Plate 71. The Bremen—Hamburg autobahn

The view, taken in 1938, illustrates one of the parking places constructed to take stationary vehicles off the road.

Plate 72. The Saarbrücken—Mannheim autobahn

The view shows the country near Wattenheim.

BIBLIOGRAPHICAL NOTE

1. The official timetable, *Grosse Ausgabe Reichskursbuch*, provides much useful information on train operation and contains several maps; the issue consulted was no. 4 (Berlin, 15 December 1938). Other official works include the *Reichsbahn Handbuch* (annually, Berlin). The German railway authorities, presumably for military reasons, do not encourage the publication of many details of route information. There is a dearth of gradient profiles, for example: most of those available are found in an article by Blum, —, 'Trassierungs-Grundsätze für Eisenbahnen ausserhalb der hoch industrialisierten Gebiete', *Verkehrstechnische Woche*, 27th year, pp. 552–60 (Berlin, 1933).

2. Apart from British official sources, material is to be found in a great variety of works. Two valuable general studies are the centenary volume, *Hundert Jahre Deutsche Eisenbahnen* (Berlin, 1935), and a report by L. J. L. Lean on a visit to the German State Railways, 1927–9 (duplicated, Great Western Railway, London), although the latter is out of date in relation to some aspects, e.g. goods train operation. An article of great general value is Wiener, L., 'Note on Train Speeds: Germany', *Bulletin of the International Congress of Railway Associations*, English edition, vol. 19, pp. 1707–86, 2005–41 (Brussels, 1937). The *Statistique Internationale des Chemins de Fer 1938* (Paris, 1938) provides general and comparative statistics.

3. For the history of the German railways useful works in English are Clapham, J. H., *Economic Development of France and Germany 1815–1914* (Cambridge, 1928); Hirst, M. E., *Life of Friedrich List* (London, 1909); Lardner, D., *Railway Economy* (London, 1850); and Treitschke, H, *History of Germany in the Nineteenth Century*, trans. Paul, E. and C., vols. 6 and 7 (London, 1919). Benaert, P., *Origines de l'industrie Allemand* (Paris, 1933), provides much useful information on the history of the railways in relation to industrial development. Of the numerous works in German the following may be mentioned: the centenary volume, *Hundert Jahre Deutsche Eisenbahnen* (Berlin, 1935); Kech, E., *Geschichte der deutschen Eisenbahnpolitik* (Leipzig 1911); Klomfass, H., *Die Entwicklung des Staatsbahnsystems in Preussen* (Hamburg, 1900); Lentz, F., *Friedrich List* (München and Berlin, 1936); Leyden, A. van D., 'Eisenbahnen', *Handbuch der Staatswissenschaften* (Jena, 1909); Meyer, A. von, *Geschichte und Geographie der deutschen Eisenbahnen von ihre Entstehung bis auf die Gegenwart* (Berlin, 1891); Schreiber, —, *Die Preussischen Eisenbahnen und ihre Verhaltnis zum Staat, 1834–74* (Berlin, 1874). General works in German on the development of communications, such as those mentioned on p. 190, may also be consulted.

4. A considerable periodical literature provides articles on railway working, construction and economics. Among periodicals in English mention may be made of the *Bulletin of the International Railway Congress Association*, English edition (Brussels), *The Engineer* (London), *Journal of the Institute of Transport* (London), *Modern Transport* (London), *Railway Gazette* (London), and *Railway Magazine* (London). Among periodicals in German the more important include *Organ Fortschritte des Eisenbahnwesens* (Berlin); *Verkehrstechnik* (Berlin); and *Verkehrstechnische Woche* (Berlin). The last-named, for example, publishes special articles on *Rangiertechnik*, i.e. marshalling yard operation. The engineering aspect of railway study is provided for by frequent articles in *Zeitschrift des Vereines deutscher Ingenieure* (Berlin), and in periodicals devoted to civil engineering, such as *Die Bautechnik* (Berlin) and *Zentralblatt der Bauverwaltung* (Berlin).

5. Railway traffic is fully tabulated by the *Statistischen Reichsamt* in the *Statistik des Deutschen Reichs*, Band 522, 'Güterbewegung auf deutschen Eisenbahnen' (two volumes, annually), of which the latest issue generally available is for 1937 (Berlin, 1938). Many of the periodicals mentioned devote some space to questions of

traffic and rates. Separate returns of goods traffic according to the *Reichsbahndirektionen* are compiled by the Reichsbahn, but are not generally available to the public, even in Germany; limited information on this aspect of goods traffic is, however, published from time to time in the annual *Reichsbahn Handbuch.*

A useful reference book which contains many references to German (and other continental) railways is Sherrington, C.E.R., *Economics of Rail Transport in Great Britain* (2 vols., London, 1928 and 1937). An analysis of road and rail competition is provided by Wohl, P., and Albitreccia, A., *Road and Rail in Forty Countries* (Oxford, 1935). For the question of competition between waterway and railway the *League of Nations Report of the Special Commission on Competition between Railways and Waterways* (Geneva, 1929) is most valuable, although out-of-date in some respects.

An interesting comparative study of road, rail and waterway transport is Teubert, W., 'Die Bedeutung der verschiedenen Verkehrsmittel in Deutschland', *Comptes Rendus du Congrès Internationale de Géographie 1938*, tome II, pp. 137–58 (Leiden, 1938).

References to railway traffic will be found in various studies in economic geography, too numerous to be listed: a good example is Dickinson, R. E., 'Mitteldeutschland; the Middle Elbe Basin as a Geographical Unit', *The Geographical Journal*, vol. 103, pp. 211–25 (London, 1944). References to the rail traffic of the German ports will be found in Chapters I and II of this volume under 'Trade'. Some mention is made of railway traffic in Germany as a whole by Dickinson, R. E., *The Regions of Germany* (London, 1945).

Some account of the financial aspects of the railway system will be found in Macmahon, A. W., and Dittmar, W. R., 'Autonomous Public Enterprise; the German railways', *Political Science Quarterly*, vols. 54, 55 (New York, 1939, 1940).

6. The following articles deal with some aspects of the railways of Berlin—they are concerned more with general transport questions, but contain several interesting maps: Heuer, G., 'Der künftige Nahverkehrseinsatz in der Reichshauptstadt Berlin', *Verkehrstechnik*, Heft 19, pp. 332–6 (Berlin, 1939); Jänecke, —, 'Die verkehrliche Bedeutung der Nord-Süd-S-Bahn in Berlin; Anhalter Bahnhof—Stettiner Bahnhof', *Verkehrstechnische Woche*, 27th year, pp. 605–12; and Remy, —, 'Die Nord-Süd S-Bahn Anhalter Bahnhof—Stettiner Bahnhof im Rahmen der Grossberliner Verkehrsproblem', *Verkehrstechnische Woche*, 27th year, pp. 709–23 (Berlin, 1933); Niemeyer, R., 'Städtebau und Nahverkehr', *Verkehrstechnik*, Heft 18, pp. 434–9, Heft 19, pp. 453–5 (Berlin, 1939).

7. Two miscellaneous works are Liepmann, K., *The Journey to Work* (London, 1944), and *Ingenieurbauten der deutschen Reichsbahn* (Deutsche Reichsbahn Gesellschaft, Berlin, 1928): the latter contains illustrations and details of many bridges and some stations and water-towers.

Chapter IV

ROADS

Historical Background: Road Administration: Road Construction and Transport Conditions: *Deutsche Alpenstrasse*: *Reichsautobahnen*: Road Traffic: The Road Network: Road Bridges over the Rhine: War-time Conditions, 1939–44: Bibliographical Note

Although railways and waterways form the backbone of the German communications system, the roads of the country have in the last decade assumed a growing importance in the national economy. They had a haphazard local development, and were not designed for long-distance traffic, although in some areas they were of greater importance owing to the difficulty of building adequate railways. Road construction became an important feature of government policy under the National Socialist regime. The autobahnen scheme is an outstanding aspect of this policy, and though it was incomplete in 1939 it had provided several long-distance roads of both economic and strategic importance. These roads have many special features and must be considered apart from the main roads, which have themselves undergone considerable improvement.

The best main roads in Germany are, generally speaking, equal to the highest European standards. If all roads are taken into consideration, however, on an average they compare unfavourably with those of Great Britain and France. There are only 123 miles of roads per 100 sq. miles of area (Great Britain 229, France 184), and in terms of population the country has only 1 mile of road to every 527 inhabitants (Great Britain 256, France 107). In addition, the surfaces of the roads are not so good and they have a smaller average width. They are, on the other hand, superior to those found in Austria.

Historical Background

The Roman Period

The Roman Empire included only a portion of the territories of the modern German Reich. Little effective penetration was made to the east of the Rhine or to the north of the Danube. The German provinces were frontier districts and their roads served mainly military needs. But as the commerce of these regions developed the roads were used also by traders. Raetia had timber, particularly maple and

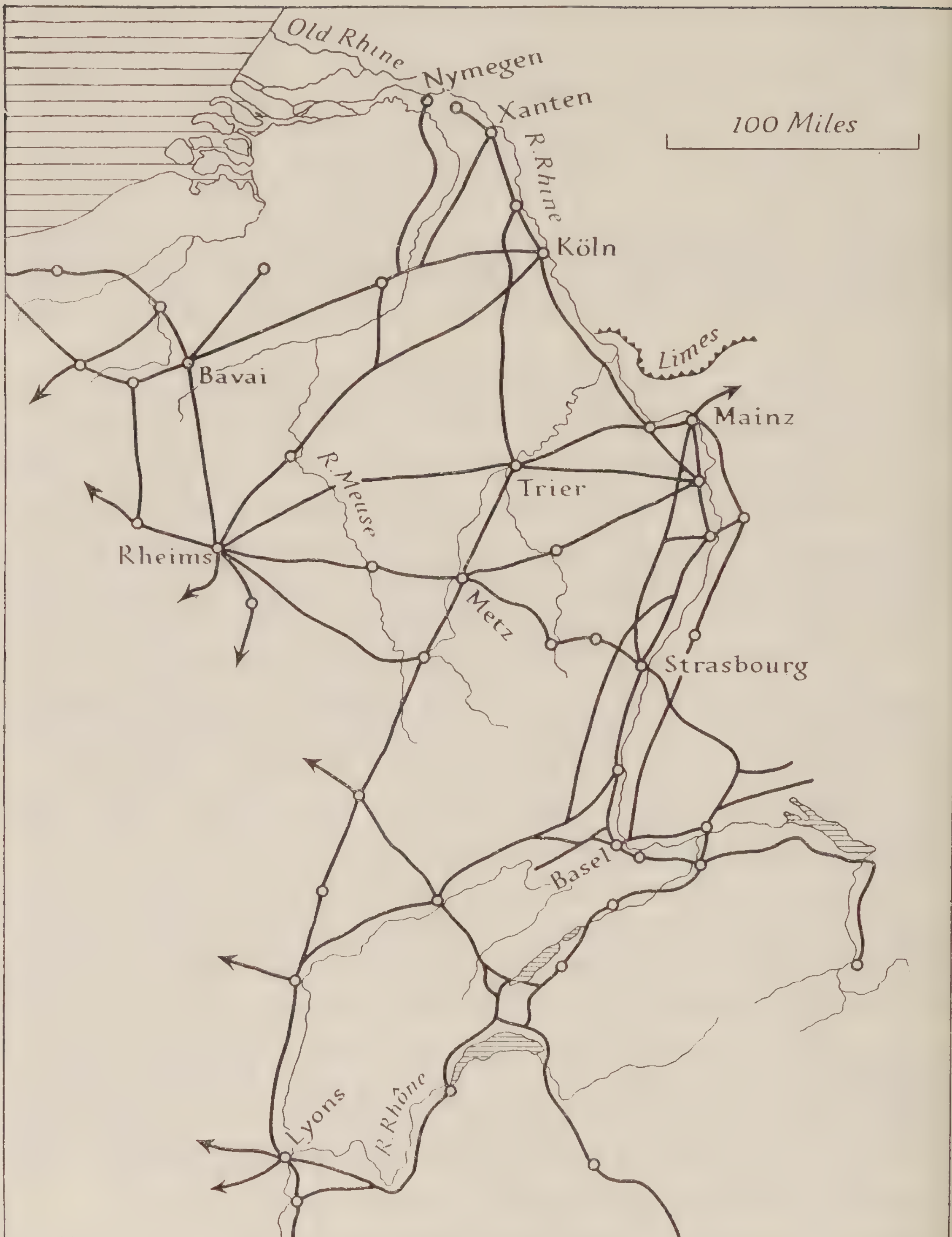

Fig. 101. Roman roads in the Rhineland

Based on Febvre, L., and Demangeon, A., *Le Rhin*, p. 45 (Paris, 1932) and other sources.

Köln (Cologne), Mainz and Strasbourg were the dominant road centres on the Rhine in Roman times, with Bavai, Rheims, Metz and Lyons as some of the more important foci to the west. Some authorities give a road leading from Bonn westwards to Boulogne. The map of Roman roads in Gaul, in the N.I.D. Handbook on France, vol. IV, p. 335, shows how the main roads in the Rhineland were linked with the network in Gaul. The 'Limes' was a series of frontier positions extending from the Rhine to the upper Danube: it continued from the position shown on the map southwards to Lorch, and then eastwards.

larch; in the valleys of the Rhine, Mosel and Danube there were vineyards; the Rhineland had some pottery works (e.g. at Saverne) and glass works (e.g. at Saverne and near Köln). Much of Roman Germany consisted of thickly wooded hills and swamps, and this restricted both settlement and road-building.

Augsburg (Augusta Vindelicorum) in northern Raetia was the focus of a network of roads running northwards to the Danube—e.g. to Regensburg (Castra Ratisbona)—and southwards through the Alpine passes to Italy. To the east a road linked Augsburg with the province of Noricum. Among the important roads west of the Rhine were those radiating from Trier, Köln and Strasbourg (Fig. 101). From Trier (Augusta Treverorum) there were roads to Köln, Koblenz, Mainz (across the Hunsrück), Bavai (across the Ardennes) and Rheims. From Köln (Colonia Agrippina) roads ran to Trier and also down the left bank of the Rhine to Leiden and up the river to Strasbourg. From Bonn a road ran to the coast at Gesoriacum (Boulogne): it 'was carried over the marshy intervening country along a series of embankments, causeways and bridges'. From Strasbourg (Argentoratum) there were—in addition to roads along the Rhine—routes westward to Saverne (Tabernae) and over the Vosges to Toul and Metz and also eastwards through the Black Forest to the upper Danube. On the right bank of the Rhine there appear to have been comparatively few roads. Such centres as Worms, Ladenburg and Baden Baden were linked by roads. Domitius Ahenobarbus built a 'long causeway' from the lower Rhine to Ems (Amisia).

Most of Germany lay outside Roman influence, and, as a rule, traffic moved on primitive paths and on the rivers. There were moor paths (*Bohlwege*) in the marshy districts of northern Germany which were made of turf and sand lying on a foundation of parallel treetrunks; the whole structure floated on the marsh. The most important trade routes in this period were those by which amber found its way from the Baltic to Italy. One route followed the valley of the Elbe, while another ran from the mouth of the Vistula across eastern Europe to Pannonia.

The Early Medieval Period

At the time of the Carolingian emperors the best German roads were the old Roman highways. Rhineland towns of political and ecclesiastical significance—e.g. Köln, Trier and Mainz—were important road centres. As the power of the Carolingians was extended eastwards new roads linked growing centres of ecclesiastical and com-

mercial activity, such as the Magdeburg road (through Westphalia); the Lower Elbe road to Bardowiek; the road from Dorstadt to Bremen and Hamburg; and the Erfurt road (through Thuringia). Most highways were poor in quality, however, and no attempt was made to move heavy or bulky goods on them.

The Carolingian emperors fostered road building, since the extension of their political power, the progress of Christianity, and the expansion of commerce all depended upon the maintenance of an adequate road system. The emperors were financially interested in the highways. Two types of toll were levied on the medieval German highways on travellers other than knights, priests and pilgrims. Some tolls were intended to raise funds for the building and upkeep of the roads, while others were customs duties (transit dues), which provided money for the general maintenance of the administration. The powerful territorial lords began to levy private illegal tolls of their own—sometimes on the plea that this was necessary to defray the expenses of protecting travellers from bandits—hence regulations were made that road dues should be levied only at customary rates and at customary places, and that no one should force travellers to deviate from 'legal' to 'illegal' roads or to pay dues to unauthorized persons. Gradually, however, the territorial princes gained various rights over the roads at the emperor's expense.

The Later Medieval Period

By the fourteenth century, at the time of the Hohenstaufen emperors, Germany's network of roads had been considerably extended. New trade routes had been opened up. New districts east of the Elbe had been developed by traders, missionaries and soldiers. In western Germany some of the Roman roads had been replaced by new routes: traffic between Koblenz and Trier, for example, went by way of Polch instead of Mayen, while traffic from Trier to Mainz went through Kreuznach instead of through Bingen. On the whole, however, the network of roads was only very slowly adapted to new economic or political needs. Erfurt, for example, became a considerable road centre in the days when the city was the headquarters of the Saxon princes, and these highways survived long after the decline of Erfurt as an important political centre.

Most of the roads of medieval Germany had no firm foundation and were of poor quality. Many of them avoided the valleys with their easy gradients because of the danger of floods in winter. It was not uncommon for roads to follow a watershed, and such names as

the 'high way' (*Hoher Weg*) and 'mountain road' (*Bergstrasse*) recall how often traffic used routes that ran across high-lying country. Sometimes roughly parallel roads in the valley and on the hillside —*Talweg* and *Bergweg* or *Sommerweg* and *Winterweg*—were used according to the state of the ground and the season of the year.

The main roads in the fourteenth century lay principally in the Rhineland, south Germany, central Germany, Thuringia; others traversed eastern Germany, while several important roads ran towards the Alpine passes.

Rhineland. There were two main roads from Utrecht to Basel by way of Köln and Mainz. They divided at Mainz, from which one route went along the left bank of the Rhine and the other ran across the foothills of the Odenwald and through Offenburg and Freiburg. From Offenburg a road branched off to cross the Black Forest to Villingen and Donaueschingen. The Rhine roads were the last stage of the great medieval commercial route by which oriental produce reached Flanders and northern Europe by way of the Mediterranean, the Italian ports and the Alpine passes. The roads on the lower Rhine —particularly those starting from Köln (see p. 440)—were the terminus of the Hanseatic trade route linking Hamburg, Bremen and Flanders with Russia and the Baltic States.

South Germany. There were important routes from the Alpine passes through south Germany to the Rhineland and to the central regions of the Reich. From the valley of the upper Inn a road crossed the Fern Pass to Kempten, Ulm, Cannstatt, Bruchsal and Speier in the Rhineland. Augsburg was linked with the upper Inn and the Brenner Pass by roads to the Fern Pass and to the Seefeld Pass (Scharnitz), and the city was also the starting-point of an important route to Würzburg. Nuremberg, too, was a great road centre in medieval Germany. Roads radiated to Würzburg, to Bamberg (for the Main valley), to Regensburg (for Vienna) and to Fürth (for Bohemia). Other medieval roads in south Germany that deserve mention were those from Regensburg to Waldsassen and Eger (Bohemia) and the 'Salt Road' from Salzburg to Munich. While some of the south German roads were only of local importance, others were essential links in international traffic between Venice, the Rhineland and Flanders.

Central Germany. Roads ran across the central German highlands from old-established political, commercial, ecclesiastical and cultural centres in the west to more recently settled 'colonial' lands in the east. Several of these routes started from Frankfurt-am-Main and Köln,

From Frankfurt three main roads ran to Eisenach on the threshold of the Thuringian passes. The most direct route was through the Kinzig valley, to Fulda and Vach, where there was an old-established crossing of the river Werra. The second road went northwards along the Weser valley to Giessen and then turned east to Alsfeld, Hersfeld and Vach (the *Weg durch die kurzen Hessen*). The third road went to Giessen, Kirchhain, Waldkappel, and then across the river Werra (the *Weg durch die langen Hessen*). The second and third of these roads were the principal routes by which merchandize from Thuringia, Silesia, Poland and Russia reached the fairs of Frankfurt-am-Main.

From Köln an old and busy road—the *Hellweg*—ran through Westphalia and Lower Saxony. Originally this route joined Paderborn and Duisburg and ran along the watershed between the Ruhr and the Lippe. Subsequently the route was extended eastwards to Minden, and at the western end much of the traffic turned south at Dortmund for Hagen and Köln. Minden was on two important roads. One (the *Hesseweg*) came through the Fulda valley from Würzburg and ran along the right bank of the Weser to Bremen. Another (the *Hellweg von dem Santforde*) skirted the north side of the Deister Hills to Hanover, from which a road led to Brunswick and Magdeburg. A parallel route linked Hildesheim with Halberstadt and Magdeburg. South of the *Hellweg* a road ran from Köln to Iserlohn and Soest. Köln and Frankfurt-am-Main were joined by the *Hohe Strasse* which crossed the Westerwald.

Thuringia. Thuringia developed into an important traffic centre. Eisenach, which was linked with Frankfurt-am-Main by three main roads, was the starting-point of two routes to Leipzig and Halle. One of these (the *Oberstrasse*) went by way of Erfurt, Eckartsberga and Weissenfels. The other went to Weissensee and then joined the *Oberstrasse* at Eckartsberga. From Weissensee there was a road to Halle, Dessau and Berlin. From Erfurt a road ran through Thuringia to Jena, Altenburg and then to Meissen (by Dresden). Nordhausen, too, was a road centre; there were routes to Tilleda, Göttingen and Halle. Two roads ran from Brunswick to Erfurt (one on each side of the Harz) and then across the Thuringian Forest (by the route known as the *Waldstrasse*) to Suhl and Bamberg. From Leipzig there were two routes through Thuringia to Nuremberg—one through Jena and Coburg and the other through Altenburg, Zwickau, Plauen and Hof.

From a commercial point of view the markets of central Germany

Plate 73. The Munich—Bad Reichenhall (Salzburg) autobahn

This view, showing a bridge near Bergen, is taken looking southwards towards the foothills of the Alps, at a point where the road crosses the double-track railway from Munich and Rosenheim to Freilassing and Salzburg.

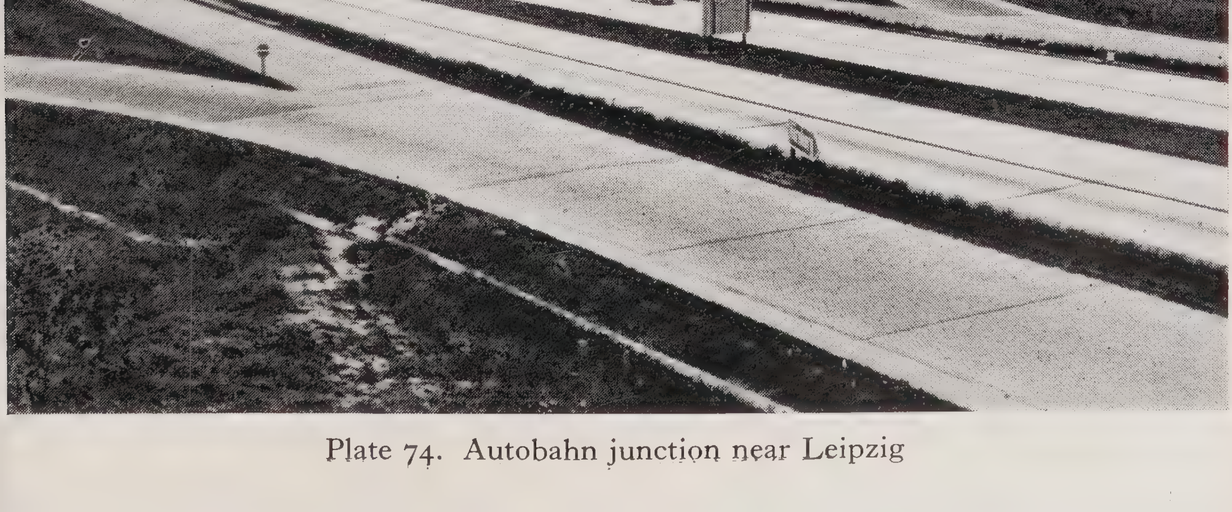

Plate 74. Autobahn junction near Leipzig

Plate 75. The Berlin autobahn ring

The view shows the southernmost point of this road.

Plate 76. The Stuttgart—Ulm autobahn: Drachensteiner Hang

The Drachenstein incline occurs where the road makes a second ascent of the Swabian Jura limestone escarpment. For a distance of about 5·5 miles the carriageways separate: the eastern carriageway is built along the rocky slope of the Drachensteiner Hang, with a gradient of 1 in 12. Along the steep face of the hillside three bridges are necessary. The western carriageway follows the southern slope of the Fils valley and reaches the plateau through a 1,968-ft. tunnel. See also p. 368 and Plate 96.

served by the Thuringian routes (e.g. Leipzig) linked both the trade of the south German cities (e.g. Augsburg and Nuremberg) with that of the Hansa cities in the north (e.g. Hamburg) and the markets of Russia and Poland with those of the Rhineland (e.g. Köln and Frankfurt).

Eastern Germany. East of the Elbe several routes developed to carry traffic to and from the new 'colonial' districts of the Reich. From Magdeburg a road went to Brandenburg, Berlin, Frankfurt-an-der-Oder and Posen. Berlin became the centre of a network of roads running through the Mark Brandenburg. One went to Stettin; another to Bromberg, Thorn and Danzig; and a third to Leipzig. From Leipzig roads ran to Posen and Thorn and also (the *Hohe Strasse*) to Bautzen, Görlitz, Breslau and Teschen.

The Alpine Passes. The main medieval Alpine routes were of great commercial significance to Germany. The Great St Bernhard had been the most popular route between Italy and western Germany since the days of the Carolingians. The Little St Bernhard pass (much used in Roman times) was less frequented in the Middle Ages. The St Gotthard Pass was opened to commercial traffic in the thirteenth century when the main natural obstacle of its northern approach (the Schöllenen gorge of the upper Reuss) was overcome. A bridge was built and so a route was opened between the Reuss and Tess valleys. East of the St Gotthard the Septimer was the most popular pass. In the eastern Alps, the Brenner—which was low enough (4,495 ft.) to avoid heavy winter snows—carried much traffic. On the German side of the pass the Brenner road ran to Innsbruck, from which roads radiated to Basel (Arlberg Pass), Augsburg (Fern Pass), Munich (Seefeld Pass) and Vienna.

Sixteenth to Eighteenth Centuries

During the sixteenth and two following centuries the network of Germany's roads was extended. The individual sovereigns were responsible for the highways and each aimed at improving transport conditions in his own territories. The needs of the Reich as a whole were hardly considered at all. Traffic on the German highways changed with the development of new international trade routes. After the discovery of the Cape route to India, oriental products came to Europe by way of the Indian Ocean and the Atlantic, and not through the Mediterranean and the Alpine passes. Some of the routes in south Germany lost traffic while new routes from Antwerp, Bremen and Hamburg became important. The rise of Hamburg and

Bremen as centres of road-networks in northern Germany was a striking feature of road developments in the Reich in the sixteenth and seventeenth centuries. Leipzig and Frankfurt a.M. retained much of their importance as markets in central Germany, but goods now reached them from the North Sea ports rather than from Italy. Leipzig owed much of its prosperity to its trading connexions with eastern Europe and Russia. The bad state of most of the roads and the lack of vehicles still hampered the transport of heavy or bulky goods overland. In 1769, for example, there was a shortage of coals in the Duchy of Cleves: a contractor, who agreed to supply 270,000 cwt. a year, in fact brought only 30,000 cwt. since the highways were so poor and it was so difficult to get carts.

The development of passenger coach traffic and of postal services encouraged the improvement and extension of the road system in the seventeenth and eighteenth centuries. There were somewhat primitive passenger coach services from Strasbourg to Frankfurt a.M. and to Basel in the eighteenth century. The territories of the Archbishop of Magdeburg were served by a network of coach services in 1670–80. In 1705, the Thurn and Taxis postal authorities introduced new coaches on the routes between Nuremberg and Leipzig and between Nuremberg, Frankfurt a.M. and Köln. These vehicles held eight passengers and carried luggage and 'express goods' (e.g. light samples used by commercial travellers). Early in the eighteenth century the journey from Memel to Berlin took 104 hours (4 miles an hour), and in 1754 one could go from Berlin to Potsdam in 4 hours (9 miles an hour). Postal services—the Thurn and Taxis organization and others—also developed. Brandenburg-Prussia, for example, had 70 post offices in 1688 and 106 in 1713. The income of the Prussian post office rose from 80,000 thalers in 1688 to over 1,000,000 thalers in 1786. To speed up postal services 'Post Routes' began to develop. Normally, existing roads were used, but sometimes old roads were greatly improved and short cuts were made. Occasionally a new 'Post Road' was constructed parallel to an old road. Some idea of the density of horse-drawn traffic on the German roads at the end of the eighteenth century may be gathered from the fact that in 1793 some 70,000 horses passed through the little town of Lüneburg, to the south of Hamburg.

The development of a system of firmly constructed modern highways—*Chaussées* or *Kunststrassen*—began on a very modest scale in the middle of the century. The first such roads were made in south Germany—principally in Württemberg. There was a metalled road

from Nördlingen to Oettlingen in Bavaria as early as 1753. At the beginning of the nineteenth century Germans accustomed only to the primitive roads of Hanover and other parts of the North German Plain marvelled at the more substantial highways of Württemberg and Bavaria. The roads from Frankfurt a.M. to Switzerland and to Vienna were reported to be particularly good. In Prussia little road-building was attempted in the first threequarters of the eighteenth century. Frederick the Great did much to foster the economic development of the newly acquired province of Silesia, but as far as

Fig. 102. *Chaussées* (*Kunststrassen*) in 1801

Based on Matthias, W. H., *Neueste Post Karte von Deutschland und dessen angrenzenden Ländern* (Berlin, 1801).

The map from which this illustration is taken was issued under the authority of W. H. Matthias, who was secretary and registrar to the postal organization of Prussia. The entire map shows Germany fairly well covered by a network of roads of differing quality, classified by the type of post service which operated along them, e.g. couriers on horseback, post coaches, post coaches and couriers, etc. The *Chaussées* or *Kunststrassen*, however, were separately classified. They were metalled roads, of which very few were found in the northern half of Germany. A Aachen; Kz Koblenz; L Liége; Lm Limburg; M Maastricht; Wzg Würzburg.

highways were concerned he merely improved two military mountain roads—one from Schweidnitz to Glatz and the other from Schweidnitz to Landeshut. It was only after about 1788 that Prussia began to improve her main roads; in 1791–3, for example, a modern highway was constructed between Berlin and Potsdam.

The network of roads in western Germany was improved in Napoleon's day, when the frontiers of France were extended first to the Rhine and eventually to the Baltic. Some of the most important roads built at this time started from Mainz and ran to Metz (for Paris), to Trier (over the Hunsrück), to Koblenz and to Bremen. In the north a great road was constructed from Hamburg to Wesel on the Rhine (for Paris). In 1815–16, when the Rhineland and Westphalia were incorporated in Prussia, these two provinces contained well over half (57%) of all the modern highways in the kingdom. This was due partly to the recent road-building of the French in western Germany and partly to technical difficulties attending the construction of roads in the sandy and marshy regions east of the Elbe.

Early Nineteenth Century

Despite some improvements in the latter part of the eighteenth century and during the Napoleonic period, the condition of the highways in Germany in the early years of the nineteenth century was, on the whole, unsatisfactory. Roads were generally narrow, with many sharp corners and steep gradients. The surface was rough in the summer and extremely muddy in winter. Journeys were practically always slow and were sometimes dangerous. In 1814 a coach in Thuringia became stuck in a great hole filled with snow and the travellers were rescued by a detachment of Russian soldiers. In 1816 a traveller took 5 hours by coach to cover the 12 miles between Weimar and Erfurt. In eastern Germany some of the main roads were so bad in the winter that from 16 to 20 horses were required to draw a Post Office coach. In the early twenties the Berlin-Breslau post-coach carried only three passengers and took 40 hours for the journey. In certain districts in Upper Silesia some industrialists united to pay for the construction of private roads out of their own pockets. As late as the autumn of 1844 some furnaces at Halemba in Upper Silesia were temporarily closed, since the roads were in such an unsatisfactory state that neither coal nor iron ore could reach the works.

Immediately after the Napoleonic Wars Prussia had embarked

upon a programme of road-building in order to link the old and the new provinces of the kingdom and to foster economic progress. Since some important industrial districts—particularly Upper Silesia and the Saar—lay on the frontiers, it was necessary to improve the country's network of roads so that these regions might get better access to raw materials and to markets. In 1815 Prussia had about 2,000 miles of main roads maintained by the state and another 475 miles maintained (with or without tolls) by other public authorities. They were mostly situated around Berlin and in the newly acquired territories in the Rhineland and in Westphalia.

In the next fourteen years over 2,800 miles of new public highways were built at a cost of 11,000,000 thalers. Among the most important roads built at this time were those from Leipzig to Frankfurt a.M., from Bremen to Wesel-am-Rhein, and from Berlin to the Rhine through Arnsberg. Some of these roads ran partly through non-Prussian lands. Schön in West Prussia and Vincke in Westphalia were particularly active in promoting the construction of roads in these years. How urgent the problem was in Westphalia may be judged from the fact that in 1830 Harkort alleged that the Westphalian iron industry could not develop since the coal and iron lay 46 miles apart. In 1816, Westphalia had 421 miles of public highways, but when Vincke died in 1844 the province possessed over 1,000 miles of main roads. In the neighbouring province of the Rhineland an English traveller described the main roads as 'luxurious' in 1845.

There was another factor which entered into the situation in the twenties and thirties. German states, to some extent, used road-building as a weapon of tariff policy. In Prussia, Maassen's Tariff Law of 1818 (see vol. II of this Handbook, p. 166) had abolished most internal dues and had transferred the collection of customs duties to the frontiers. Then Prussia began to absorb small enclaves of other states into her customs system and in 1828 a customs union was formed with Hesse-Darmstadt. Many of Prussia's neighbours feared that Prussia would be able to extend her economic influence at their expense. Hanover, Saxony and some of their small neighbours formed the Middle German Commercial Union which tried to stop Prussia from gaining control over the main routes by which foreign goods reached the markets of Leipzig and Frankfurt a.M. by way of Hamburg and Bremen. Members of the Union planned to construct a highway from Frankfurt a.M. to Cassel and Hanover, where roads would leave for Hamburg and Bremen. Another road was to be built in Thuringia to link Leipzig with Frankfurt a.M. None of these

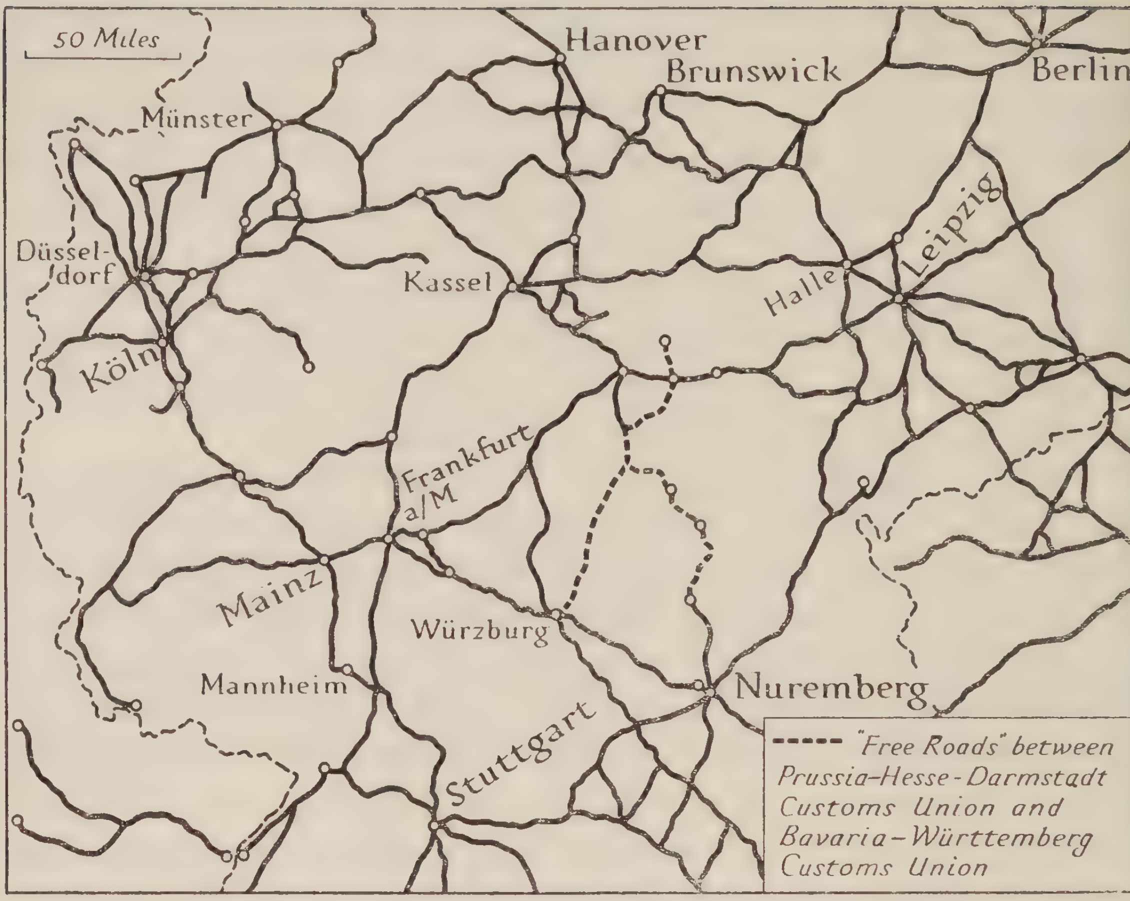

Fig. 103. Main roads in central Germany, 1834

Based on Henderson, W. O., *The Zollverein*, p. 73 (Cambridge, 1939).

The 'Free Roads' linking the Prussia-Hesse-Darmstadt Customs Union with the Bavaria-Württemberg Customs Union ran through the territories of small Thuringian states (see also Figs. 33, 34 and 37 in vol. II of this Handbook).

roads would touch Prussian territory. But not even a common fear of Prussia put an end to the petty rivalries of the members of the Middle German Commercial Union, and the proposed new roads were not completed.

Prussia, however, was able to improve the commercial links between north and south Germany by building roads through the territories of the Thuringian principalities of Meiningen and Gotha. A road was built from Magdeburg to Bamberg which crossed the Erfurt—Frankfurt a.M. highway. An extension was planned from Magdeburg to Hamburg. When the Zollverein was established in 1834 commerce flowed in its natural channels and some of the highways built during the struggle between Prussia and the Middle German Commercial Union soon declined to the position of second-class roads. Throughout the area of the Zollverein there was a marked increase in road traffic immediately after 1834.

Development of Modern Roads

The great age of modern road-building in Germany, however, was in the middle years of the nineteenth century. Prussia, for example, had a network of nearly 18,000 miles of main roads in 1862, about half of which were maintained by the state and half by the local authorities. By 1900 Prussia had some 60,000 miles of highways. At about the same time Bavaria had 15,000 miles of main roads; Saxony 2,354 miles of state highways; Württemberg possessed 1,948 miles of state roads, and Baden had 1,906 miles of main roads.*

Public Main Roads in Prussia in the Nineteenth Century (in miles)

Highways maintained by the state		All main highways	
1816	1,932	1862	18,000
1826	3,075	1876	40,000
1831	4,149	1891	50,000
1841	5,888	1895	53,000
		1900	60,000

From: (1816–41) J. H. Clapham, *The Economic Development of France and Germany, 1815–1914*, p. 108 (3rd ed., Cambridge, 1928); (1862) N.I.D. Handbook, *Germany*, vol. II, p. 175; (1876–1900) Werner Sombart, *Die deutsche Volkswirtschaft im 19en Jahrhundert*, p. 247 (6th ed., 1923).

Figures after 1876 include mileage of roads in territories gained by Prussia in the sixties of the nineteenth century.

The development of modern roads in Germany differed in two respects from the development of roads in England three-quarters of a century earlier. In England a network of modern highways had been constructed long before the railway age. In the Reich, on the other hand, road-building and railway-building went hand in hand. In England the roads were nearly all constructed by private enterprise: turnpike trusts built roads and secured the right to levy tolls upon them. In Germany most roads were built out of public funds. Private turnpikes were comparatively rare, and they never played an important rôle in the development of Germany's highways. It was not until 1843 that a road was built by a private company in Prussia.

While the capital cost of new highways in Germany normally came out of the rates and taxes, maintenance charges were met from funds raised by tolls levied on the roads. But nearly a third (30%) of the income derived from such dues was swallowed by the costs of collection. When the Zollverein was established (1834) its members agreed on maximum rates for road tolls. Between 1820 and 1840 the south

* It should be noted that the road statistics of different federal states are not strictly comparable. They serve, however, as a rough-and-ready guide to road-building developments.

German states abolished these dues. Prussia and other north German states followed suit for the most part in the last third of the nineteenth century. Mecklenburg-Strelitz did not get rid of the last of its road tolls until 1915.

In the nineteenth century the transport of passengers by road was to a great extent in the hands of the post offices of the various federal states. The passenger service of the Prussian postal authorities (re-organized in the twenties by Nagler) and of the famous old-established Thurn & Taxis post office were particularly efficient and comfortable. Here Germany differed from England, where passenger coaches on the roads had been run by private enterprise. Werner Sombart estimates that—despite the development of railways—the number of passengers using post coaches in Germany increased from about 3,000,000 in 1840 to about 6,000,000 in 1855. Shortly after the unification of Germany nearly 7,500,000 passengers used the post coaches in a single year (1873). Then at last the effects of railway competition made themselves felt. The passenger traffic handled by the post offices declined to 4,500,000 in 1910. Over half of these passengers (2,700,000) used the Bavarian post coaches and many of them were no doubt tourists in the Bavarian Alps.

Some idea of the extent to which the business of transporting goods by road flourished in Germany throughout the nineteenth century—despite the existence of railways and inland waterways—may be seen from the statistics concerning the number of persons employed in the road transport industry. In 1846 there were in Prussia 18,670 people working in this industry (*Fracht- Stadt- und Reisefuhrwesen*). By 1895 in the same territory * the number had increased to 50,622. In Bavaria, Saxony and Baden the number of persons engaged in road transport rose from 8,220 to 19,836 between 1846 and 1895. A traffic census in Saxony in 1899 showed that horse-drawn vehicles carrying goods (*bespannte Fuhrwerke*) using the Saxon highways had increased by nearly 40% since 1870.

Both passengers and goods, however, were being moved for considerably shorter distances by road at the end of the nineteenth century than they had been in the fifties. Long-distance traffic had by 1900 fallen to a great extent into the hands of the railways and—so far as certain goods were concerned—of the inland waterways. In the rapidly-growing towns the trams and buses—both originally

* i.e. excluding the territories annexed by Prussia in the sixties of the nineteenth century. The figure does not include persons employed in the tramway service.

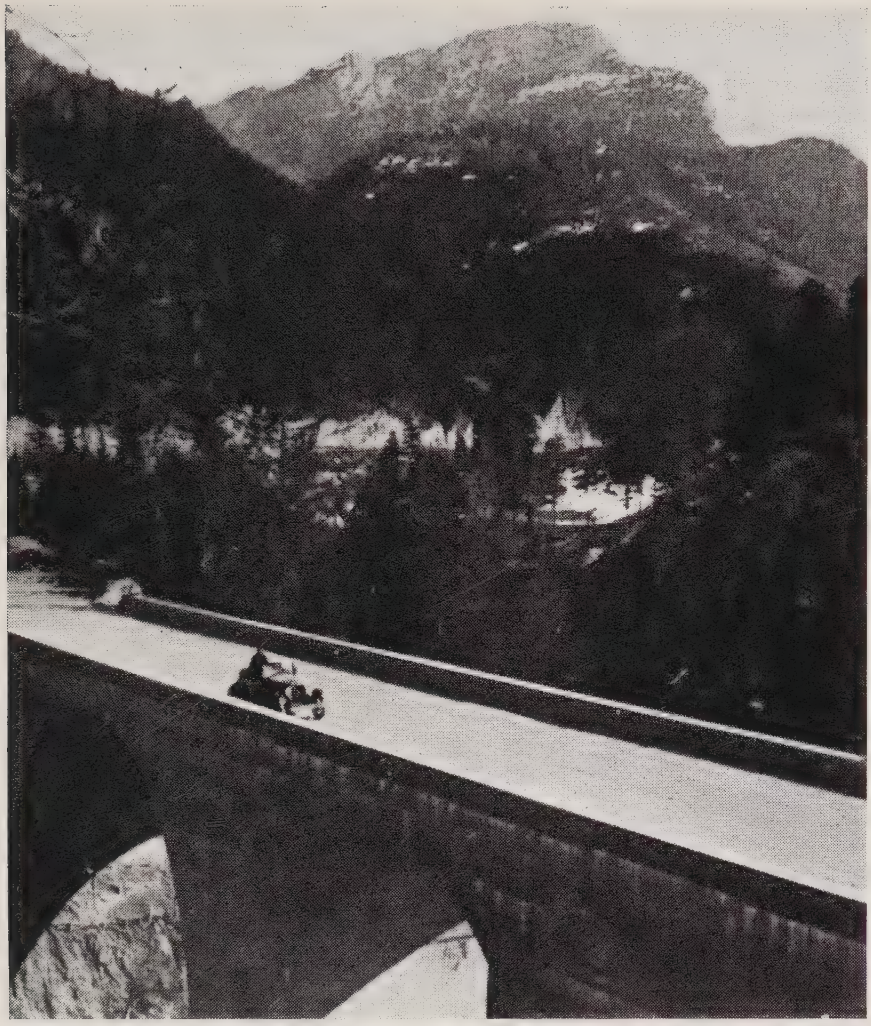

Plate 77. *Deutsche Alpenstrasse:* Pfannloch bridge near Mauthaüsl (Bavaria)
After crossing a watershed to the south of Inzell the road descends by the narrow valley of the Weissbach: deep tributary ravines necessitate two lofty bridges close together at Pfannloch and Höllenbach.

Plate 78. *Deutsche Alpenstrasse:* Saalach bridge (Bavaria)
In the background is the Reiteralpe. This view was taken a few miles to the south of the location shown in Plate 77.

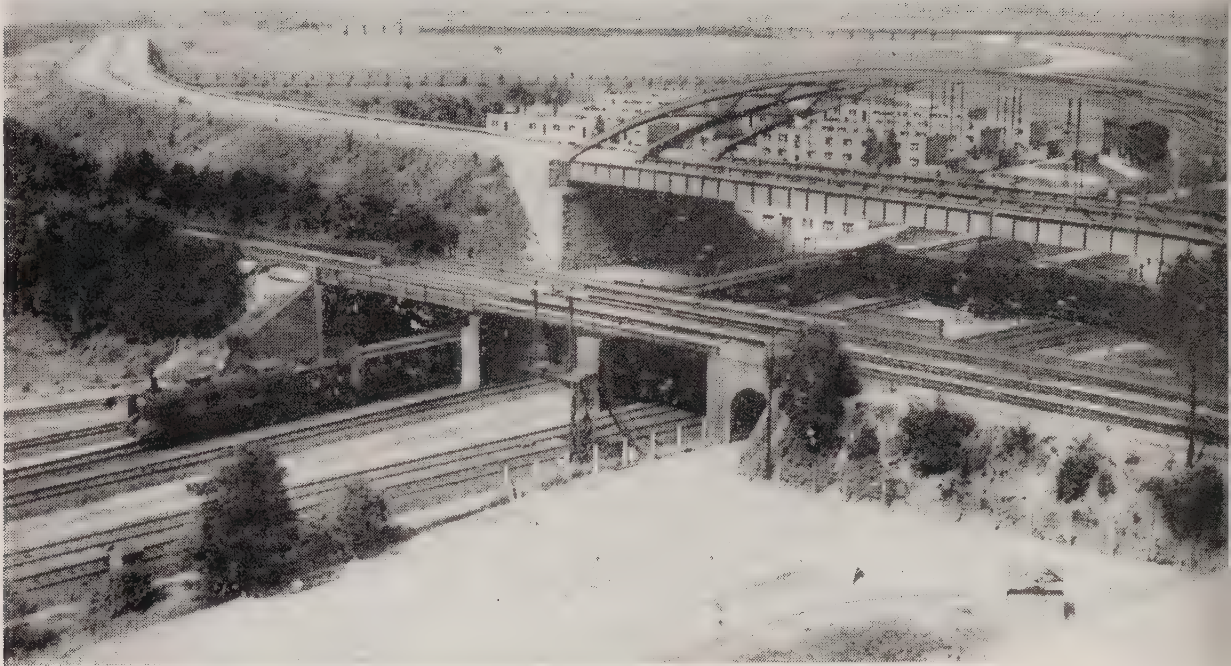

Plate 79. Autobahn bridge at Duisburg-Kaiserberg, looking north

The crossing comprises two steel bowstring arched bridges, side by side, one for each roadway; the overall length is 400 ft. The Köln—Berlin autobahn leaves Duisburg to run northwards to Sterkrade before turning eastwards through the Ruhr towards Hanover. At Duisburg-Kaiserberg it crosses over two double-track railways from Duisburg, which diverge to Oberhausen and Styrum, and runs parallel to the four-track line from Duisburg-Wedau to Oberhausen. In the middle distance is a bridge over the river Ruhr carrying a loop line. The view shows the flat plain of the lower Ruhr just above Ruhrort (off the picture to the left). Beyond the distant edge of the plain are Hamborn, Meiderich and Oberhausen, backed by the low wooded hills east of the Rhine between Sterkrade and Dinslake.

Plate 80. The Aachen—Jülich *Reichsstrasse*, looking east

The surface is composed of stone setts. Like many *Reichsstrassen*, this road is bordered by trees, which are dangerous on curves in the event of a vehicle skidding. On each side of the road is a smooth track for cyclists.

drawn by horses—played an important part in the conveyance of passengers. In Berlin, for example, the number of passengers using the omnibuses rose from 12,500,000 in 1860 to nearly 170,000,000 in 1913, while in the same period the number of people using the trams increased from 960,000 to 623,000,000.

The development of motor-cars and motor-lorries in the twentieth century—particularly after the war of 1914–1918—brought new life to the roads of Germany. Within the frontiers of 1919 the number of motor-cars (*Personenkraftwagen*) increased from 55,000 in 1914 to 433,200 in 1929, while motor-lorries (*Lastkraftwagen*) rose from 9,100 to 144,000 in the same period. In 1932 there were 150,000 motor-lorries in the Reich, of which 9,259 (and 2,415 trailers) were licensed for long-distance traffic. Even so, there were far fewer motor vehicles in proportion to the population than in the United States or Great Britain.

Under the Weimar Constitution it was the duty of the Government of the Reich to build public highways (*Landstrassen*) which carried long-distance through traffic or were needed for purposes of military defence (Article 7, section 19). Some improvements in Germany's road system were made during the Weimar regime to deal with the growing motor traffic. But it was not until Hitler came to power that a grandiose scheme for a network of arterial motor roads was drawn up. Military and economic motives were both present in the minds of those responsible for planning the *Reichsautobahnen*. Dr Todt was largely responsible for carrying out the initial stages of the plan. Hitler opened the first short stretch of the new highway system (Frankfurt a.M.—Darmstadt) in May 1935, and by the spring of 1938 just over 1,250 miles of autobahnen had been opened to traffic.

Road Administration

Divided authority has characterized much of the history of the German road system since the early nineteenth century, in contrast to that of France, which since the Napoleonic era has benefited from a high degree of centralization. Under the Second Reich there was no central body for the management of roads, for they were not considered as essential to the national economy as the railways, which were developed in close association with the General Staff and were designed to meet strategical needs as much as economic requirements.*

* The unification of the railway system made much more progress in 1871–1918 than the unification of the roads, but the complete unification of the railways did not take place until after 1919 (see p. 215).

The railways and waterways carried almost all long-distance freight traffic and the railways predominated in passenger and local traffic of all types. During the war of 1914–1918 the railways were called upon to fulfil the function for which they were intended and the road system deteriorated considerably. During the period of the Weimar Republic, and indeed up to 1934, a continued deterioration in the road system was offset to a certain extent by improvements in road surfaces which were made to accommodate the increase in road traffic and in the number of privately-owned motor vehicles; such improvements were, however, restricted to the major traffic routes, largely owing to the unstable economic conditions prevailing in the country. Moreover, each of the seventeen states and each of the various provincial and municipal authorities was responsible for the construction and upkeep of roads in its own area, although in some cases main highways were planned and constructed by the central government. This lack of co-ordination, therefore, resulted in considerable variations in the standard of improvement in different parts of the country.

National road administration was unified for the first time by the Third Reich in 1934, when the creation of a supreme department of road construction and maintenance was embodied in a law of 26 March. All federal state and municipal rights in road planning were abolished by the law, which affected particularly the smaller administrative units; their participation was only allowed in the management of roads of purely local significance. It has been estimated that the nationalization of the road administration reduced the number of responsible authorities from 700 to about 30. The reorganization followed the introduction of the autobahnen scheme in 1933 (see p. 467) and was, indeed, a necessary corollary to it. Supreme control was given to Dr Todt as Inspector-General of Roads (*Generalinspektor für das deutsche Strassenwesen*) and all authorities charged with any of the administration and maintenance of roads were made responsible to him.

Before the simplification, the road network was divided into state and provincial roads (*Staats- und Provinzialstrassen*), district roads (*Kreis-*(*Bezirks-*)*strassen*), and communal or urban roads (*Gemeindestrassen*); in addition there were some private and forest roads. The main roads were reclassified into *Reichsautobahnen* (Reich motor highways), *Reichsstrassen* (Reich roads, roughly equivalent to the French *routes nationales* and British first-class roads), *Landstrassen I Ordnung* (Provincial roads, first class), and *Landstrassen II Ordnung*

(Provincial roads, second class). In 1936 there was a total of 131,813 miles of *Reichsstrassen* and *Landstrassen*, composed of 40,310 miles of former state and provincial roads, 65,118 miles of district roads, 25,057 miles of communal and urban roads and 1,328 miles of private and forest roads. The re-grading of roads of various former classes into the new categories was as follows:

Present category	Percentage of former category			
	State and provincial roads	District roads	Communal roads	Private roads and forest and Reichsbahn roads
Reichsstrassen	84·26	7·73	7·60	0·37
Landstrassen I. Ordnung	32·30	53·58	13·35	0·87
Landstrassen II. Ordnung	3·70	65·03	29·80	1·44

From: *Statistisches Jahrbuch für das deutsche Reich, 1938*, p. 240 (Berlin, 1938).

In 1937 the total length of *Reichsstrassen* was 25,675 miles, of *Landstrassen I Ordnung* 52,354 miles, and of *Landstrassen II Ordnung* 54,155 miles. Provisional totals for 1938 show a larger mileage of main roads, but this has been largely achieved by reconstruction and up-grading rather than by new construction; thus the mileage of *Reichsstrassen* increased but that of *Landstrassen I Ordnung* decreased. In addition to these roads, there were 61,007 miles of *Gemeindestrassen* in communes of more than 1,000 inhabitants, and they included some connexions through the communes for the main roads.

Reichsstrassen are built and administered exclusively by the national authorities under the Inspector-General of Roads, whose jurisdiction operates through state and provincial authorities. The *Landstrassen I Ordnung* are supervised by the Inspector-General and he provides technical officials to serve on their administrative boards; the maintenance costs are, however, borne by the state and Prussian provinces. In the case of the *Landstrassen II Ordnung*, the Inspector-General determines their supervision after consultation with the Minister of Finance and the Minister of the Interior. The allocation of the administration of these roads either to provincial authorities or to urban and communal authorities is largely governed by the degree to which they serve national or local requirements. The *Gemeindestrassen*, which in most cases amount only to country lanes, are maintained by local authorities.

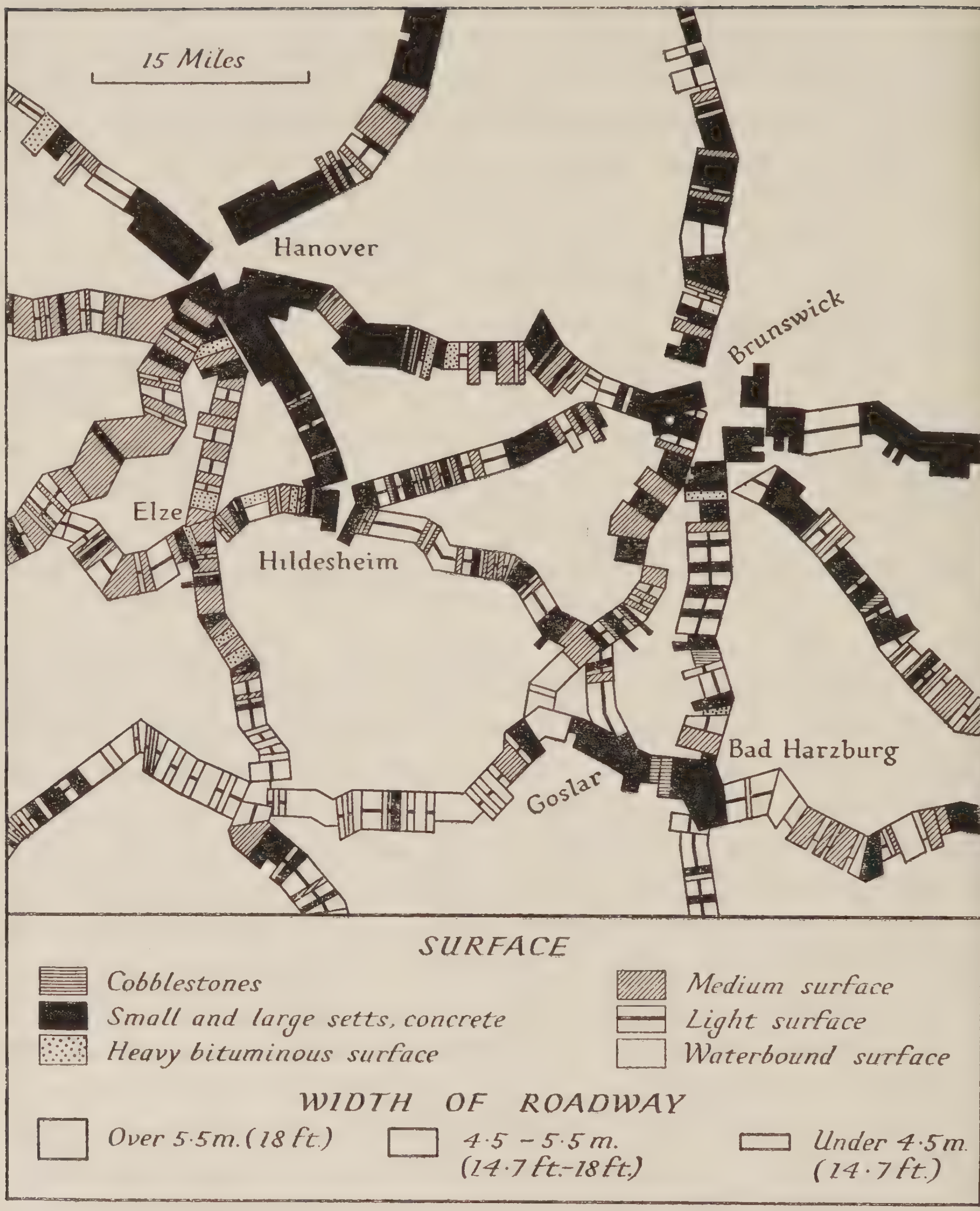

Fig. 104. Road surfaces and widths in the Hanover region, 1931

Based on a map in *Die Reichsautobahnen*, p. 3 (Berlin, 1938).

The figure illustrates the frequent variations of width and of surface material found in the main roads prior to 1934. Specifications were not uniform, and varied in accordance with local circumstances. The use of setts, mostly derived from the granites of the Harz (to the south-east of the map) is marked in this predominantly loess region. Lighter surfaces are noticeable on the northern margins of the Harz west of Goslar.

Road Construction and Transport Conditions

General Features

Before 1934 no uniform specifications were laid down for road construction, and for a given class of road the design varied according to local topography, to the availability of particular road materials, to local technical standards and to economic requirements. There was thus considerable variety in road surfaces and road widths. In 1931, for example, the surface of the *Reichsstrasse* between Hanover and Brunswick changed within a few miles from irregular stone setts to bituminous covering, and from waterbound macadam to cement concrete and small stone setts, while the width of the road varied between 14 and 18 ft. In some cases roads ceased suddenly at the boundary of a province, because the neighbouring state had not undertaken their continuation; if a road did continue at such a boundary it might suddenly improve or degenerate in surface. Even today, in Thuringia changes in surface conditions on the roads can be attributed to positions of former enclaves of federal states. Under the reorganized administration introduced in 1934 design specifications have been laid down for the various types of roads and many improvements have been made. Although work has proceeded intensively on the roads in order to make them conform to these standards, the roads in each category show considerable local variety in the stage of improvement reached.

In 1933 there were 39,460 miles of state and provincial roads. Some 30% of these had light and dusty surfaces inadequate for motor traffic, and 40% had protective surface layers which needed frequent maintenance, and the remaining 30% had heavy surfaces. About 25% were suitable only for one-way traffic (under 4·5 m.—14·7 ft. wide) and 46% could take double traffic (4·5–5·5 m.—14·7–18 ft. wide), if necessary. The other 31% were wider than 5·5 m. (18 ft.) and could take two or more lines of traffic. Of all these roads only 21,508 miles were taken over as *Reichsstrassen*. In four years of development to 1938 the carriageways of one-quarter of these were widened to 6 m. (20 ft.) and the overall width was increased to 8–10 m. (26–33 ft.), while one-fifth were provided with a heavy or medium surface. Only some 7% were still without a dust-free surface. In the same period more than 3,700 miles of *Landstrassen* were widened to a width of at least 6 m. (20 ft.) and some 3,000 miles were provided with heavy or medium-heavy metalling. The *Reichsstrassen* were

mostly in good condition in 1939, but for the most part *Landstrassen* are still unsuitable for high-speed or heavy traffic.

In spite of these improvements, however, *Reichsstrassen* still presented obstacles to high-speed transport, apart from those not suitable for two-way traffic. One of the chief disadvantages was the lack of adequate sight distance, more particularly on curves, owing to the sharpness of the curves, the lack of super-elevation and the proximity of trees to the roadside. Trees, which may in certain areas be fruit trees, limes, oaks or poplars, or mountain ash, as on the passes in the highlands of central Germany, commonly line the very edge of the road, and on very sharp curves restrict the sight distance almost to zero. Even on curves of a large radius, a normal sight-distance of several hundred feet may be reduced by two-thirds. New *Reichsstrassen* have a 5-ft. shoulder on each side of the road, but few have as yet been provided and most of the present shoulders are narrow and unstable. Apart from those lined with trees, nearly all of the roads offer potential dangers to traffic in the form of rows of concrete or stone posts on or near the edge of the roadway, and also electric power and telegraph poles, though the latter are declining in number with the increasing use of underground cables. A certain number of roads have bicycle paths adjacent to the carriageway, especially if the surface of the latter consists of stone setts. One of the latest *Reichsstrassen*, for example, running south-west from Brunswick, has a 29½-ft. roadway, with bicycle paths 5 ft. wide separated from it on either side by a green belt 9½ ft. wide.

Reichsstrassen are generally unsuitable for carrying large-scale or long-distance traffic since their function is to serve all important towns. The sections through these towns often form serious bottlenecks in the mazes of narrow, congested streets, of which Ulm provides a good example. Through traffic can avoid the centre of towns like Halberstadt, Münster, Paderborn, Erfurt, Kassel, Marburg, Augsburg and Nuremberg by using convenient outer streets or roads on the outskirts. Very few special by-passes have been constructed, but examples are to be found at Stuttgart, Regensburg, Herford, Unna and Soest. Furthermore, many towns still possess on their main exit roads gateways dating from medieval times, such as those at Günzburg, Zusmarshausen, Ingolstadt, Bad Neustadt, Nördlingen, and Uffenheim in Bavaria, at Lübeck in the north, and at Ahrweiler in the Eifel; many of these gateways cannot take heavy vehicles. One-way traffic was enforced, for example, in Trier and the centres of Brunswick and Oppenheim were closed to heavy traffic.

Landstrassen, with occasional exceptions, are inferior to *Reichsstrassen*. They possess in a greater degree obstructions to fast-moving traffic similar to those on *Reichsstrassen*, and these obstructions are made worse by features such as right-angle turns and humps over culverts.

Constructional Materials

Most of central and south Germany is well provided with various types of road-building materials, and there are few areas without easy access to quarries providing road metal and building stone. A few areas are of more particular importance. Granite is found especially in the Black Forest, in the Odenwald, and in the Lausitz region east of Dresden. The Harz Mountains region is another source of granite stone, which is commonly used in the roads of the *Börderland* between Hanover and Halle; good road metal is otherwise largely absent in this region of loess. In the Hanover area itself there are, however, fairly extensive supplies of limestone of Cretaceous age, as well as sand and gravel pits. In western Germany the gravel terraces of the Lower and Upper Rhine valleys form important sources of sand and gravel; similarly there are numerous gravel pits in the Main valley near Frankfurt. To the north of Frankfurt in the Vogelsberg region basalt of an inferior quality is available and basalt is also obtainable in the Westerwald. The part of Germany most deficient in road metal is the North German Plain. Although the extensive deposits of glacial material in this plain contain important beds of sands and gravels, they do not offer the necessary basic materials and these have to be imported from other parts of the country. The distribution of the chief sources of road metal in Germany is shown in Fig. 105.

Road Surfaces

German roads were originally designed to take horse-drawn vehicles, and in order to adapt them to motor traffic extensive reconstruction has been necessary. Most *Reichsstrassen*, for example, have been under constant construction and maintenance since the beginning of this century and the old foundations have largely been utilized, except in cases of widened roads. One surface of bituminous or asphalt material after another has been laid down until the original design has been obliterated. It is therefore not uncommon to find roads with similar surfaces but having different basic designs. In general, however, certain types of road construction predominate and

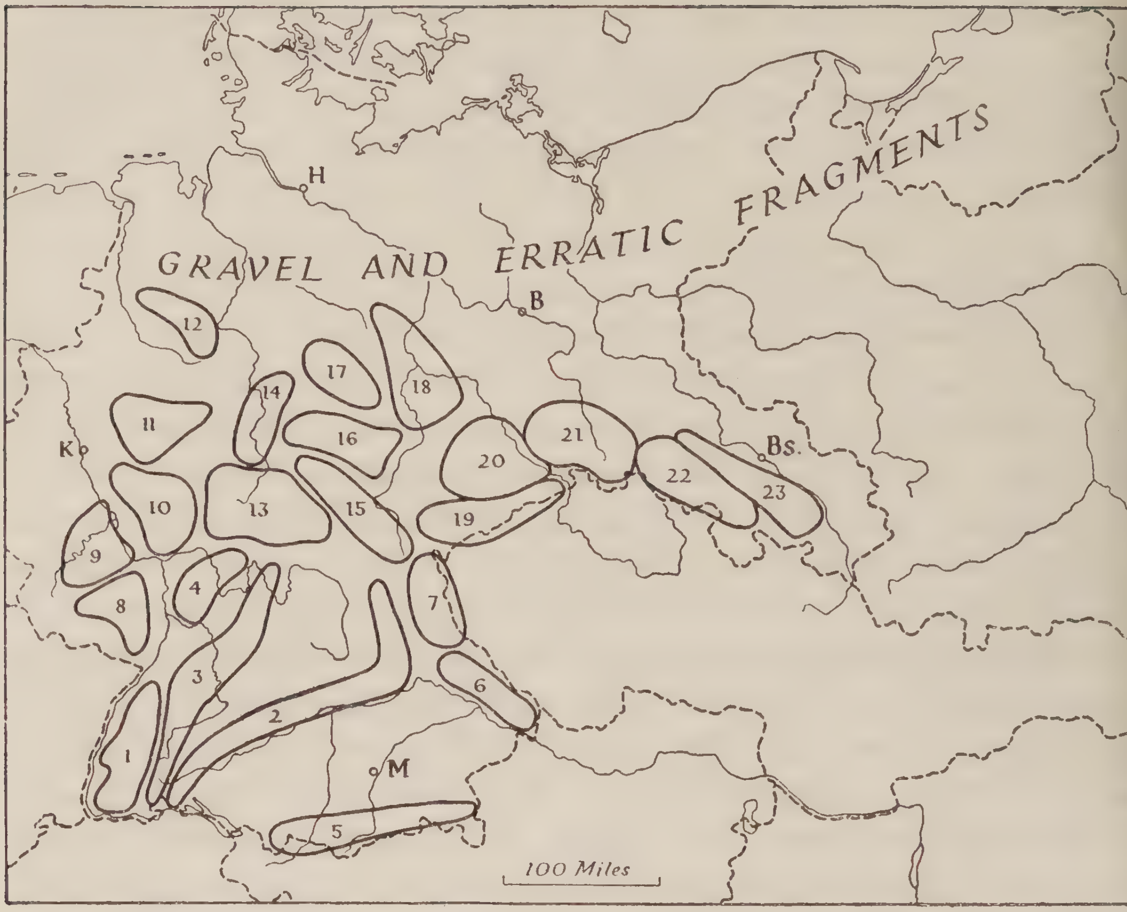

Fig. 105. Principal sources of rock for road construction

Based on official sources.

B Berlin; Bs Breslau; H Hamburg; K Köln; M Munich. In the North German Plain some road building materials are provided by gravel beds and by 'erratics', i.e., rock fragments, of various sizes, deposited by ice sheets. In the remainder of the country native rock provides a variety of road metal, the chief types of which are named below, rock types being shown by initial letters: A intrusive rock—granite, syenite, diorite, gabbro, granite porphyry; B older quartz-bearing extrusive rock—quartz and felsite porphyry, quartz-keratophyr; C older quartz-free extrusive rock—porphyry, porphyrite, metaphyr, diabase; D younger quartz-free extrusive rock—basalt, basaltic lava, phonolite; E metamorphic rock—gneiss, amphibolite, hornfels; F quartz-bearing sedimentary rocks—greywacke, quartzite; G limestone.

1. Black Forest, Kaiserstuhl (A, B, D, E); 2. Swabian-Franconian limestone, Hegau (G); 3. Swabian-Franconian shell limestone (G); 4. Odenwald, Spessart (A, B, C, D, E); 5. Alps (F, G); 6. Bayrischer Wald, Passauer Wald (A, F); 7. Fichtelgebirge, Steinwald, Oberpfälzer Wald, Kulm (A, B, C, D, E); 8. Saar-Nahe district, Haardt (B, C, D, E); 9. Eifel, Hunsrück (C, D, F); 10. Siebengebirge, Westerwald, Taunus (C, D, F); 11. Ruhr, Bergischesland, Siegerland, Sauerland (C, F); 12. Osnabrück, Wiehengebirge (F); 13. Vogelsberg, Rhön, Grabfeld (D); 14. Lower Hessia (Knüll, Habichtswald, Kauffunger Wald, Rheinhardswald, Meissner), Solling (D); 15. Thuringian and Franconian Forests (A, B, C); 16. Thuringian shell limestone district; 17. Harz (A, B, C, F); 18. Halle, Bernburg, Magdeburg, Flechtinger, Höhenzug (B, C, F, G); 19. Erzgebirge, Vogtland (A, B, C, D, E); 20. North-western Saxony (A, B, C, E); 21. Lausitz (A, B, C, D, E, F); 22. Sudeten (A, B, C, D); 23. Sudeten Vorland (A, D).

Plate 81. The Kettwig—Werden *Reichsstrasse*, looking north-east

The surface is composed of asphalt concrete (closed mix). This road runs along the north bank of the river Ruhr, where the river is about to leave the plateau country for the Rhine plain. The railway shown is the important direct line between Essen and Düsseldorf.

Plate 82. A road near Celle, in the Lüneburg Heath.

Plate 83. The *Adolf Hitler* road bridge over the Rhine at Krefeld-Uerdingen
Details of this bridge will be found on p. 499.

Plate 84. The *Admiral Scheer* road bridge over the Rhine at Duisburg-Ruhrort
Details of this bridge will be found on p. 499.

with minor exceptions these prevail over most of the country. The following table gives the percentage of the total length of each of the main categories of road under various surfaces:

Road surfaces, 1938

Type of surface	*Reichsstrassen*	*Landstrassen I Ordnung*	*Landstrassen II Ordnung*	Total
Waterbound macadam	6·3	43·1	71·6	47·9
Surface-treated macadam	38·8	33·5	11·6	25·4
Bituminous concrete and asphalt	34·4	10·2	4·4	12·4
Cement concrete	0·5	0·2	0·3	0·3
Cobblestones; natural and artificial stone setts	19·7	12·7	11·9	13·7
Unspecified	0·3	0·3	0·2	0·3

The table excludes roads in towns and cities of over 6,000 inhabitants.

From official sources.

The most widespread type of surface is waterbound macadam. Most *Reichsstrassen* were originally of this construction, in which the foundation consists of a prepared grade on which large flat-based stones, 8 to 10 in. high, are laid by hand with their broad sides down. The spaces between the 'cones' are filled in with gravel or aggregate of small-sized stones. Where heavy stone is not available a layer of coarse stone or gravel is used as foundation and this also is laid to a depth of 8 to 10 in. The foundation, which is found on the greater part of the German road system, even with varied types of surface, is consolidated by the addition of water. The surface layer consists of small stones laid to a depth of about 4 in. with fine stones for finishing off, and considerable quantities of water are used for binding; it is from this process that the surface derives its name. The surface of the road, however, frequently caves in with the penetration of water or under heavy traffic, as the gravel is forced downward into the spaces between the large stones. Constant maintenance is required on this type of road because with heavy loads of modern vehicles the surface becomes unusable and dusty in a very short time. Adequate consolidation is an integral part of this method of construction and for many years until the introduction of steam rollers hand- and horse-drawn rollers were used. Waterbound-macadam surfaces have been almost eliminated from *Reichsstrassen* owing to progressive surface treatment with asphalt and tar. The most important areas where waterbound macadam is found on *Reichsstrassen* are East Prussia, Upper Silesia, Posen-West Prussia, Oldenburg and Bavaria.

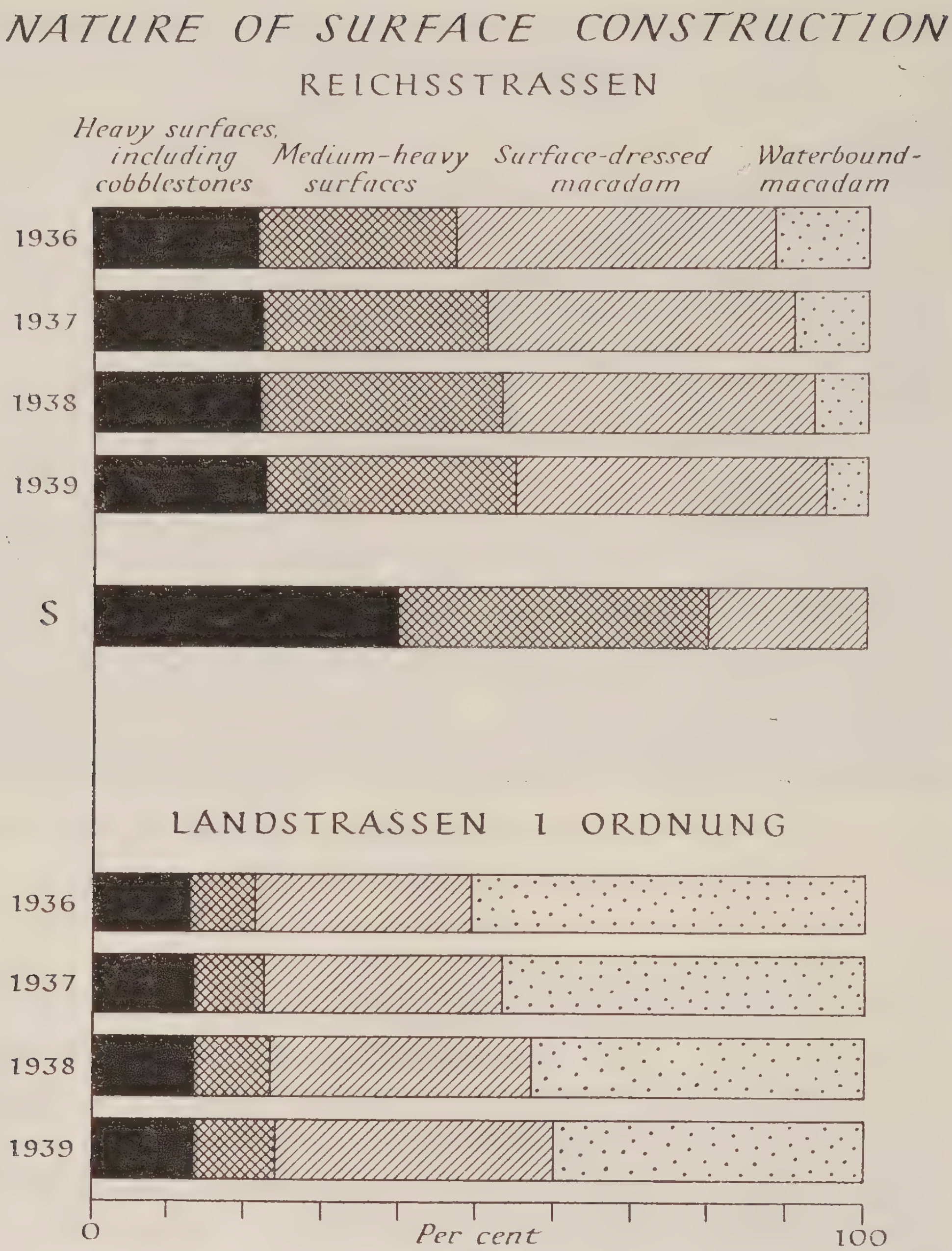

Fig. 106. Construction of *Reichsstrassen* and *Landstrassen I Ordnung*
Based on 'Die Kraftverkehrswirtschaft im Jahre 1938', p. 34, Supplement to *Wirtschaft und Statistik*, 19th year, no. 3 (Berlin, 1939).
The figure shows the gradual improvement of the surfaces on the two categories of roads. 'S' represents the percentage of each type of surface which is aimed at for *Reichsstrassen*. In this category dusty surfaces (waterbound macadam) have been almost entirely eliminated, but relatively little change has taken place in the percentage of heavy surfaces. *Landstrassen* are still largely provided with light surfaces.

On *Landstrassen* and other subsidiary roads waterbound macadam still predominates.

Surface-treated macadam surfaces make up the highest percentage of the surfaces on *Reichsstrassen*, and they also form the second most important surface on *Landstrassen I Ordnung*. Tar or bituminous material is applied to a smoothed waterbound macadam surface and

chipped stone is rolled in. The surface is, however, not sealed completely. Both waterbound macadam and surface-treated macadam are classified in German official statistics as light surfaces. Medium-heavy surfaces include tar and asphalt-bound macadam (an improvement upon surface-treated macadam roads) and bituminous and asphalt-concrete surfaces less than 2·4 in. thick. Heavy surfaces include bituminous concrete and asphalt surfaces over 2·4 in. thick, cobblestones, large stone setts, small stone setts, artificial stone setts and cement concrete surfaces.

Bituminous and asphalt concrete surfaces (made up of 5–9% tar or asphalt and large or small mineral aggregate) of all thicknesses form the second most frequent surface found on *Reichsstrassen* and are only used to a small extent for *Landstrassen*. They are suitable for the heaviest traffic and do not become slippery when wet as do, for example, some tar- and asphalt-bound macadam surfaces, especially surface-treated macadam. Old waterbound macadam roads and roads of stone setts are frequently improved by treatment with this type of surface.

Of other types of road material stone setts are most extensive and they are still laid down widely; often made from granite, they withstand the strain of modern traffic. They are similar to those used in the widespread *pavé* of France and Belgium, and are found especially on through roads in towns and villages of industrial areas such as the Ruhr, and on sudden rises and falls in gradient, where stone setts are of advantage to motor vehicles and where they resist the erosive effects of heavy downpours of rain; finally they are used on curves, where they are less likely than asphalt surfacing to cause skidding. *Reichsstrassen* are better provided in these respects than *Landstrassen*. Three main types of stone setts are found. Large setts (4–6 in. wide and 6–10 in. long with intervening spaces filled in by tar or asphalt or concrete) are suitable for large-scale heavy traffic, but not high-speed traffic owing to the rough surface. Small setts (3–5 in. cubes) are laid in rainbow patterns and often have a thin bituminous dressing which is forced into the open spaces by traffic, but the surface may be rough and not so resistant to heavy traffic as that of large setts. Artificial setts are used on special stretches of road and in areas where sufficient quantities of natural stone are not available; this type of surface is smooth owing to uniformity in size of the setts. Short stretches of cobblestones, collected from ordinary field stones, are still found in Germany, mostly in small villages. They are a relic of medieval practice and are no longer laid down owing to the

extremely rough surfaces which result. Wooden setts are also utilized, more particularly in large towns.

Cement concrete construction was seldom used in Germany before the commencement of the autobahnen scheme, and such surfaces only account for a very small percentage of the total length of roads. Since few new roads have been built as part of the main road system, old roads have usually been used as foundations for the concrete. The areas with the best road surfaces, taking the percentage of medium-heavy and heavy surfaces on *Reichsstrassen* as a base, are the province and the state of Saxony, Anhalt, the Rhineland, Westphalia, the Kassel district and Schaumburg-Lippe, apart from such areas as the Saar, Hamburg, Bremen and Lübeck.

Road Widths

The average useful width of *Reichsstrassen* is approximately 20 ft., and although many of them are not as wide as this, the majority are over 18 ft. The widest roads are found in the state of Saxony and in Bavaria, and most of the industrial areas like the Ruhr and the Wupper valleys, as well as built-up areas like Hamburg and Bremen, have roads above the average width. In Saxony, for example, 43·2% of the *Reichsstrassen* are 21 ft. wide or over, compared with an average figure for the country of 13·7%. The narrowest roads are mostly located in the remote parts of the country such as in East Prussia or in the parts of Brandenburg away from the main streams of traffic. The average width of *Landstrassen I Ordnung* is some 18 ft. and the larger part of the *Landstrassen II Ordnung* are less than 15 ft. wide. The following table shows the proportion of roads of various widths in 1937, together with preliminary figures for 1938 which reveal a progressive widening of all the principal roads:

Road widths, 1937 *and* 1938 (*percentage of total length of each road category*)

Width	1937			1938		
	Reichs-strassen	*Land-strassen I Ord.*	*Land-strassen II Ord.*	*Reichs-strassen*	*Land-strassen I Ord.*	*Land-strassen II Ord.*
Under 4·5 m. (14·7 ft.)	11·47	42·25	64·85	10·36	41·59	64·72
4·5–5·5 m. (14·7–18 ft.)	25·62	39·63	28·13	24·50	39·94	28·05
5·5–6·5 m. (18–21·3 ft.)	49·20	13·72	5·29	51·41	14·34	5·51
Over 6·5 m. (21·3 ft.)	13·71	4·40	1·73	13·73	4·13	1·72

From: *Statistisches Jahrbuch für das deutsche Reich, 1938*, pp. 238–9 (Berlin, 1938).

Road Camber

A number of the older *Reichsstrassen* have a large angle of camber. This was made necessary by the rough surfaces and an excessive camber was required to ensure a proper run-off for rain-water and so counteract subsidence in the waterbound macadam construction. In the case of roads of more recent construction, those with smooth surfaces have a camber of from 1% to 2%, and those with rough surfaces a camber of 3% to 4%. Owing to the greater prevalence of waterbound macadam construction in *Landstrassen* and the absence of much surface treatment, a larger proportion of these roads depend upon a high crown and a large angle of camber for surface drainage.

Gradients

Owing to the fact that few new *Reichsstrassen* have been built since 1934, the gradients of these roads are mostly the original ones and are frequently greater than those specified by the Ministry of Transport at that time. The maximum gradient permitted in level country is 1 in 40 and in hilly country 1 in 18. The limit in mountainous country is 1 in 16·6 with exceptions in certain cases of 1 in 12·5. Gradients are often steep on *Landstrassen* in conformity with the slopes of hills over which they pass.

Bridges

Generalizations on the types of bridges used on German roads are misleading insofar as information on construction methods varies considerably between one locality and another. Bridges over small rivers and streams are usually of the masonry arch type with relatively few of steel or reinforced concrete.

The bridges over the Rhine especially, and other wide rivers such as the Elbe and Oder, consist mostly of steel girder structures of varying designs on masonry or concrete piers and abutments. For example, between Wesel and Kehl (opposite Strasbourg), there are 22 road bridges; 18 of these are of steel construction; the remaining four are pontoon bridges or bridges of boats (Figs. 117, 118). A sample analysis of all important road bridges in part of the Rhineland gives some idea of the proportions of each type of construction. The area, some 70 miles by 90 miles in extent, consists roughly of that part of the Rhine Province bounded by a line joining Bonn and Aachen in the north, by the Rhine and the Moselle to the east and to the south, and by the Belgian and Luxembourg frontiers on the west. Many

rivers and streams dissect the Eifel massif, which forms the main part of the region analysed, so that many bridges are necessary. Of a total number of 281 bridges for which the method of construction is known, 209 (75%) were of masonry, brick or mass concrete arch type, 35 (12%) had steel spans and 37 (13%) had reinforced concrete spans. A corresponding analysis of railway over road bridges in the same area reveals that out of a total of 18 bridges, 3 had masonry or brick arches, 9 had steel spans and 6 were built of reinforced concrete. The proportions of the various types of construction will naturally vary according to locality. Steel bridges are probably more common in the main industrial areas, such as the Rhine and the Ruhr valleys, and near the large cities, and also in the northern part of the country where stone is not so readily available. Many bridges in country districts are quite narrow, even on *Reichsstrassen*, where they have not kept pace with the increase in size of heavy motor vehicles. *Reichsstrassen* are not of such a high standard in this respect as main roads in England. This is partly explained by the concentration of the Germans on autobahn construction and on the diversion of heavy long-distance traffic to these roads; thus the narrower bridges in country districts largely suffice for the needs of the light local traffic.

Vehicle ferries are found in several parts of Germany and even some *Reichsstrassen* are provided with them for crossing the large rivers. Perhaps the most important one is that across the Rhine at Emmerich, for it provides the only regular road crossing of the Rhine below the bridge at Wesel. Another important ferry crosses the Rhine from Sinzig to Linz, about halfway between the Bonn and Neuwied road bridges. Others are across the Elbe south-east of Hamburg about halfway between Artlenburg and Schnakenbeck, and two cross the Kiel C. at Brunsbüttelkoog (on the main western trunk route traversing Schleswig-Holstein to Denmark) and at Rendsburg. The remaining two *Reichsstrassen* crossing the canal, including the main eastern route through Kiel and Flensburg to Denmark, utilize bridges. In south Germany the *Reichsstrassen* largely use bridges, and ferries are almost confined to *Landstrassen*.

Effects of Weather

Snow, ice, rain and fog are all weather factors that are likely to hinder traffic on German roads, but conditions vary so much between one locality and another and from year to year that only general information is available. The relative importance of the first three is indicated by a survey of weather conditions in Germany undertaken

in the winter of 1936–7, intended as a guide to the amount of traffic interruption. The average traffic decrease in January and February for the whole country was estimated at between 15% and 20%:

Effects of Weather on Decrease of Traffic, 1936–7

Region	Traffic decrease, percentage	Nature of weather	Period
North Germany	25	Storms and wind	Oct., Nov.
Flensburg	up to 40	Snow	Jan.
Hamburg	20	Rain	Feb.
Lübeck	20	Ice	Jan.
Hanover	20	Mostly snow	Jan.
Harz	50–60	1 ft. of snow	Feb.
Brunswick	5	Snow and ice	Jan., Feb.
Thuringia	10	Snow and ice	Jan., Feb.
Saar	30	Rain	—
Bodensee (L. Constance)	20	Snow and ice	—
Black Forest	40	Snow and ice	Jan.
Baden	negligible	—	—
Württemberg	negligible	—	—
Lower Bavaria	5	Snow and ice	Jan., Feb.
Upper Bavaria	10	Snow and ice	Jan., Feb.
Passau	severe	Snow	Feb.
Alps	20	Snow and ice	—

From official sources.

Snow may be expected in all parts of Germany between October and May, but it occurs most frequently between December and March; January and February are the worst months. East Prussia, south-east Germany, the Central Highlands and, above all, the Bavarian Alps, are the regions most affected. In the mountains of the centre and south heavy snowfalls cause extensive road blocks and drifts 12–20 ft. deep. Local facilities for clearing snow or ice vary considerably, and precise information on the duration of snow-blocks on roads is not available, even in the case of the Alps. The 20% decrease of traffic in the Alps presumably relates to those areas at the foot of the mountains, for the figure would undoubtedly be considerably higher on most of the Alpine passes. Such passes as the Adolf Hitler Pass on the *Alpenstrasse* (see p. 465) and the Scharnitz Pass (altitude 3,727 ft.) on the Austrian frontier in the Isar valley, leading south from Munich to Innsbruck, and the Brenner Pass, are likely to be accessible at all seasons of the year, though they may be blocked for short spells. The table on p. 466 shows the duration of obstructions caused by

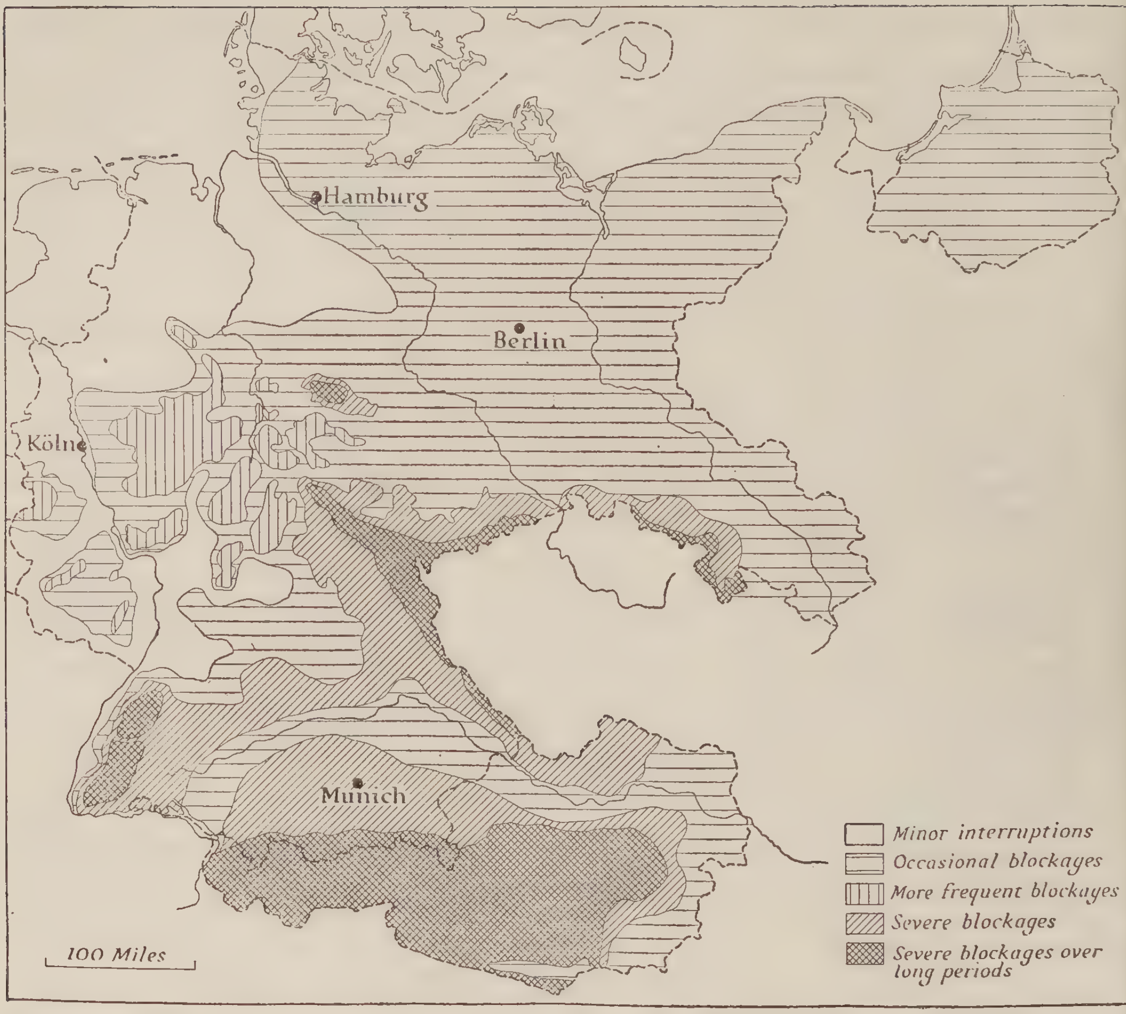

Fig. 107. Interruption of road traffic by snow and ice in Germany and Austria

Based on official sources.

1. Minor interruptions: roads likely to be affected only for brief periods in exceptionally severe weather, usually limited to January and February.
2. Occasional blockages: roads likely to be blocked by isolated drifts through icing and snow blizzards. Conditions become more severe and prolonged towards the east. Regular clearing is necessary.
3. More frequent blockages: conditions similar to (2), but with heavier snowfalls. Severe conditions are only temporary and are probable between mid-December and early March. Main roads usually follow valleys between the areas affected.
4. Severe blockages: roads are likely to be blocked by heavy snowfalls with extensive icing, mid-December to mid-March. Provision for snow clearing over large areas is necessary.
5. Severe blockages over long periods: roads are subject to blockage and icing over long periods. Conditions vary greatly with height (see p. 463). Large-scale clearing is necessary, involving the use of rotary ploughs.

snow and ice on the chief passes in the Alps, both in Germany and Austria.

The statistics for Baden and the Black Forest also provide an example of the differing effects of snow, especially, in adjacent areas of low and high altitudes. In the same winter season of 1936–7 parts

Plate 85. The *Skagerrak* bridge over the Rhine from Düsseldorf to Oberkassel
This view is taken from the left bank, looking north-east. Details of the bridge will be found on p. 499.

Plate 86. The bridge of boats, Koblenz

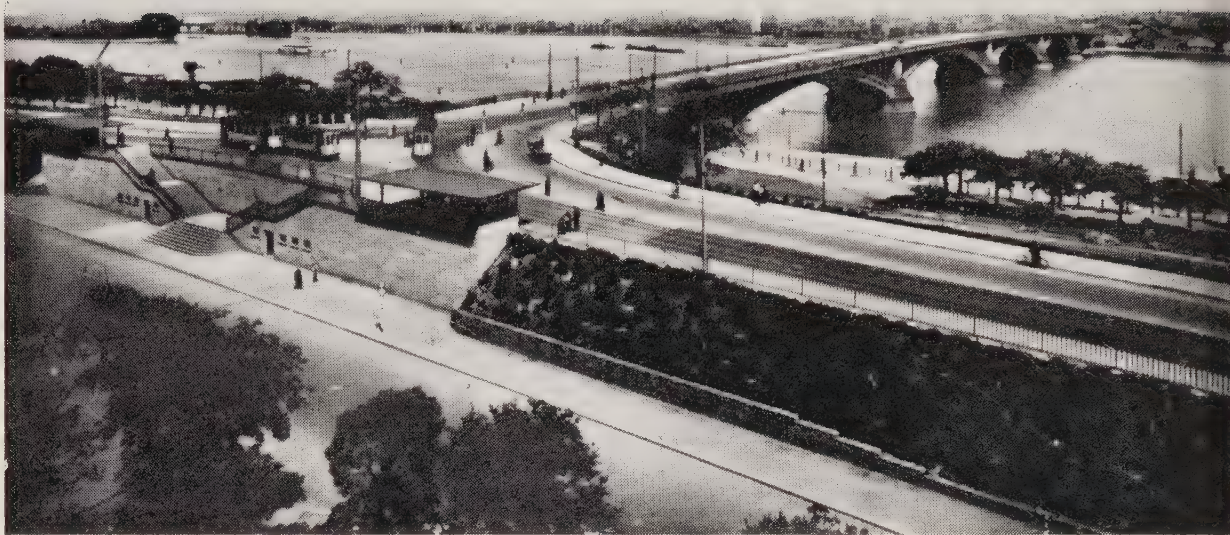

Plate 87. The Rhine bridge at Mainz
Details of this bridge will be found on p. 501.

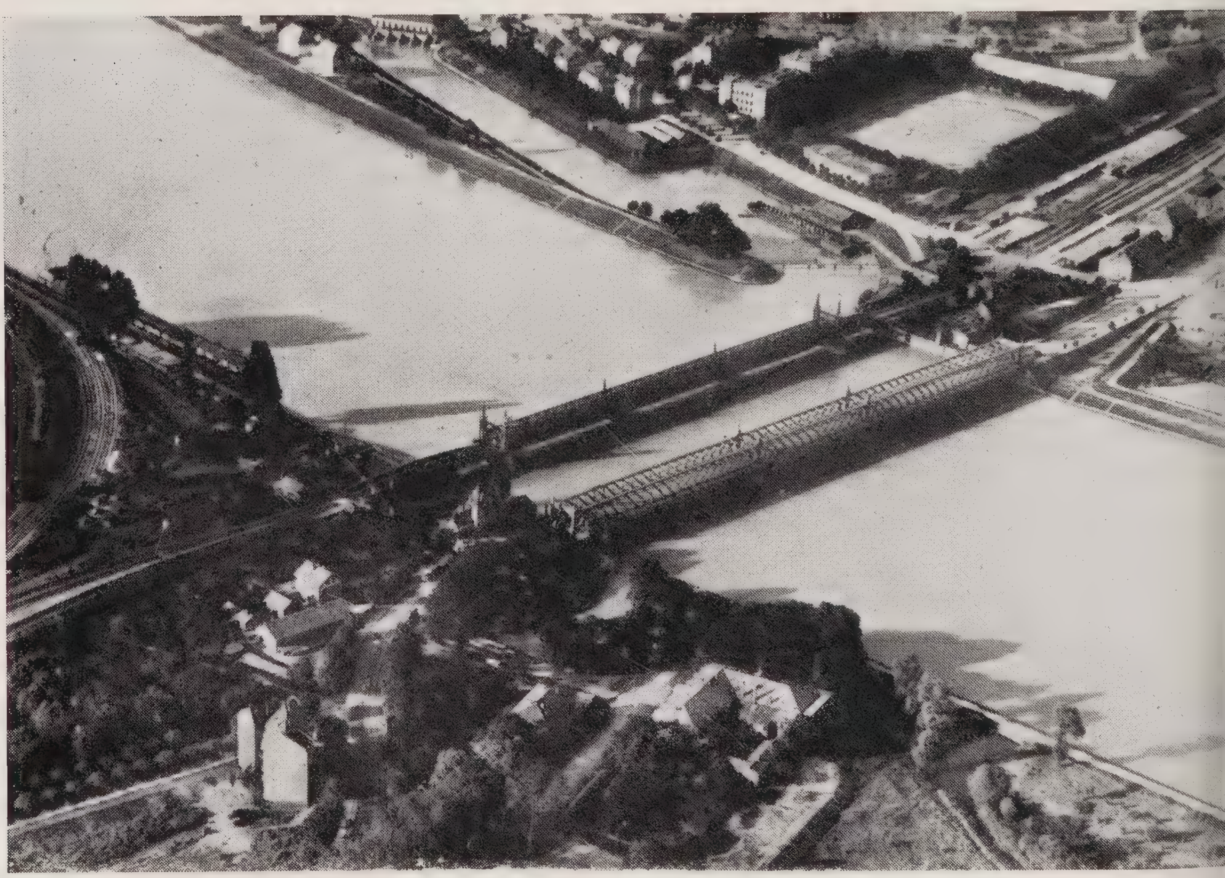

Plate 88. Road and rail bridges over the Rhine at Kehl
Details of these bridges will be found on pp. 341, 502. In this view Kehl lies on the farther bank, with the French bank in the foreground; the road bridge is the nearer of the two.

of the Bayerischer Wald near the borders of Czechoslovakia were impassable, while the adjoining lowlands and the valley of the Danube were free of obstruction. During the worst spells in most years the snow cover on low ground reaches a depth of 4–8 in. for short periods, but lasting snow cover is usually 1–4 in. deep, except in the more hilly areas, and except for occasional drifts of 3–10 ft. depth. Such drifts may be kept off the roads by the erection of snow fences at least 80–100 ft. back from the road edge and at right angles to the direction of the prevailing snow-bearing wind. The surfaces of roads under snow for any length of time deteriorate rapidly, especially if they are of light construction like waterbound macadam. Snow compacted under the weight of vehicles, and snow which, after melting, penetrates the surface layer and then freezes again, cause cracking and disintegration.

Rain and flood water assume greater importance in north Germany than in most other parts of the country owing to the large areas of marshy ground and impervious soils of glacial origin. Roads in the lake areas of Schleswig-Holstein, Mecklenburg and East Prussia are frequently built on embankments. Similar circumstances are found in the polderland of the North Sea coast and in the Rhine flood plain below Köln. Waterbound macadam roads, again, suffer severely with flooding, as the water causes subsidence in the foundations.

Fog occurs most frequently in Germany, apart from mountain areas, along the North Sea coast, particularly the lower courses of the Elbe and Weser, and in the marsh and lake districts such as Mecklenburg. Fogginess is increased by smoke and fumes in places like Hamburg and the Ruhr. German industrial areas generally suffer more from fogs than those in Britain because the air, especially in winter, is more often stagnant. These fogs are a great hindrance to motor traffic. (For further details on the incidence of the various weather elements in Germany see vol. I, ch. vii, of this Handbook.)

Deutsche Alpenstrasse

The German Alpine highway forms part of neither the *Reichsstrasse* nor the autobahn systems, and although it resembles more the roads of the latter, the principles behind its inception and its method of construction are different. It is essentially a scenic road of tourist value, though it is also of strategic importance; it is particularly important in the Bavarian Alps and the Salzburg Alps as an approach to the roads leading south to the Brenner Pass and other passes to

Chief Alpine Passes in Bavaria and Austria : Interruption of Road Traffic by Snow and Ice

Region and name of pass	Altitude of pass, ft.	Width of road, ft.	Main road served by pass: From	Main road served by pass: To	Gradients on approach to and descent from pass: From	Miles	Gradient up	Gradient down	Miles	To	Period of Obstruction (T=total, I=intermittent)
Bavarian Alps, Tirol and Vorarlberg:							1 in:	1 in:			
Arlberg	5,912	16	Landeck	Bludenz	St Anton	4	8½	7½	5	Langen	December–April I
Brenner†	4,495	16–20	Innsbruck	Bolzano	Innsbruck	23½	7½	7½	9½	Vipiteno	December–April I
Fern*	3,967	13–16	Germisch	Landeck	Lermoos	6	12½	16½	6	Nasserreith	December–April I
Flexen*	5,853	13–16	Reutte	Arlberg	Stuben	3	6½	7½	3	Lech	November–May I
Reschen-Scheideck (Resia)†	4,902	13	Landeck	Merano	Stuben	12½	6½	14½	5½	Resia	December–April I
Scharnitz (Seefelder or Zirlerberg)*	3,727	13–16	Innsbruck	Mittenwald	Zirl	3½	4	6	8½	Scharnitz	December–April I
Strub and Stein	2,211–1,732	16	St Johann i.T.	Salzburg	Erpendorf	7½	11	8½	11/26	Lofer/Bad Reichenhall	December–April I
Thurn	4,177	13–16	Kitzbühel	Zell a. See	Jochberg	6	10	12½	6	Mittersill	December–April I
Tauern:											
Grossglockner	8,215	20	Zell a. See	Lienz	Fusch	16	8½	8½	9	Heiligenblut	mid. Oct.–late June T
Katschberg	5,384	13–16	Radstadt	Spittal	Rennweg	3½	4	3½	4	St Michael	early Nov.–mid May T
Tauernhöhe (Radstadt)	5,702	13–16	Radstadt	Spittal	Radstadt	14	5	7	11	Mauterndorf	early Nov.–mid May T
Triebener Tauern (Hohentauern)	4,148	13	Trieben	Judenberg	Trieben	5½	4½	10	6	St Johann i.T.	December–April I
Steiermark:											
Prebichl	4,026	16	Hieflau	Leoben	Vordernberg	4	5	4½	3½	Eisenerz	December–April I
Pyhrn	3,100	13	Liezen	Wels	Liezen	4½	5½	5½	5	Spital a.P.	December–April I
Semmering	3,215	26–33	Vienna	Leoben	Schottwien	6	12½	20	8	Mürzzuschlag	December–April I
Stubalpe	5,089	10–13	Graz	Judenberg	Köflach	12	5	6	11	Weisskirchen	December–April I
Salzkammergut:											
Gschütt	3,252	10–13	Bad Ischl	Golling	Gosau	1	4½	8½	9	Abtenau	December–April I
Pötschenhöhe	3,222	16	Salzburg	Leoben	Aussee	5	6	5	4½	Goisern	December–April I
Lueg	1,818	16	Salzburg	St Johann i.T.	Golling	2	9	10	4	Sulzau	December–April I
Kärnten:											
Gailbergsattel	3,182	16	Oberdrauburg	Kötschach	Oberdrauburg	4½	12½	14½	3½	Kötschach	December–April I
Iselsberg	3,950	13	Spittal	Lienz	Dölsach	5	12½	8½	2	Winklern	early Dec.–mid Apr. I
Loibl‡	4,482	13–16	Klagenfurt	Ljubljana	Unterloibl	7	4½	3½	3½	Sveta Ana	early Dec.–mid May T
Packsattel	3,826	20	Graz	Klagenfurt	Köflach	12	12½	12½	9½	Twimberg	December–April I
Plöcken †	4,462	13–20	Oberdrauburg	Tolmezzo	Mauthen	9½	6	5½	4	Timau	early Dec.–mid May T
Seeberg (Jazerko)‡	3,990	13	Völkermarkt	Kranj	Eisenkappel	8½	14½	10	7½	Kokra	December–April I
Wurzen‡	3,514	10–13	Villach	Kranj	Riegersdorf	4½	4½	5½	2	Podkoren	early Dec.–mid Apr. T

From official sources.
The principal trans-frontier passes are indicated as follows:
* Germany—Austria
† Austria—Italy
‡ Austria—Jugoslavia
Owing to varying weather conditions in different years, passes may be crossed at times between the dates given.

northern Italy and Austria. Work was started on the road in 1937 and when completed it was to link Lindau on Lake Constance with Berchtesgaden. Consequently it was to serve the whole length of the German Alps, which it follows close to the Austrian frontier for some 200 miles. Five main sections had been completed in 1939 (Fig. 113), and in the majority of instances these used existing alignments of *Reichsstrassen* and other roads. The four most important sections are in the Allgäuer Alps, starting from Lindau, with another section crossing the Adolf Hitler Pass (altitude 3,734 ft., with gradients of 1 in 7), from Oberstdorf to Füssen, in the Bavarian Alps, and in the Salzburg Alps, from Ruhpolding to Berchtesgaden and Königssee. The section of the road to Berchtesgaden was completed in 1937.

The highway has been designed with only one carriageway $29\frac{1}{2}$ ft. wide, but in practice all stretches have not been raised to this standard and they may be as narrow as 18 ft. The surface on sections with a gradient of less than 1 in 20 consists of asphalt-bound macadam or other bituminous material. On hairpin bends and other sharp curves and on gradients greater than 1 in 20 small granite setts 3–4 in. thick are laid to provide greater tractive resistance. The road is well engineered and the curves are well laid out with sufficient super-elevation. The planned angle of camber is 3%. Numerous embanking walls and reinforced concrete bridges of simple design are utilized. *Reichsstrasse* 2, leading south from Munich to the Austrian frontier and the Brenner Pass, includes part of the *Alpenstrasse* between Oberau and Klais. The stretch between Munich and Oberau was enlarged to at least 22 ft. width in 1935 to carry the bulk of the traffic to the Winter Olympic Games held at Garmisch-Partenkirchen, between Oberau and Klais. Its surface is chiefly bituminous, with some stone setts, but it is composed of concrete near the Eschenlohe tunnels, a few miles north of Oberau.

Reichsautobahnen

The *Reichsautobahnen* (Reich motor highways) are perhaps one of the most imposing engineering projects yet undertaken by any government in recent decades, and they take first place among the works of National Socialism. The idea of super motor highways was not new when it was introduced in Germany, for there were precedents in the *Autostrada* of Italy, the first of which was proposed in 1922 and opened in 1925; the Federal Highways in the United States of America offer another parallel. What was new, however, in the German scheme was its ambitious scale, intended to cover the whole country.

The scheme was announced soon after the National Socialists came to power in 1933, but even before 1930 the construction of highways with separate traffic lanes had been undertaken on a small scale. The state highway scheme was a development of one inaugurated by the private *Hafraba* (Hamburg—Frankfurt—Basel) company, which intended to build a network of highways to be financed by mileage fees; the first road to be built by it was to run from Hamburg to Frankfurt-am-Main and Basel. The undertaking failed, however, owing to lack of funds for construction. One of the first objectives of the National Socialists' scheme was the relief of the severe unemployment in the country. Such an unemployment relief scheme was thought to be advantageous because no raw materials would have to be imported, all the necessary materials being obtainable in Germany. No loss of foreign exchange would therefore be involved, and any outlay of the state could be regained by special taxation of the road users as was done in Italy. There was, however, undoubted propaganda value to be gained from such tangible evidence of the vitality of the new regime. Furthermore, the highways were obviously intended to serve strategic purposes to a greater degree than the roads of Germany had ever done before. The scope of the scheme was also one additional expression of the policy of economic nationalism. All areas of economic, and of so-called 'cultural', importance were to be linked by direct highways.

Legislation providing for the construction of the new roads was introduced on 27 June 1933, and on 25 August 1933 the *Reichsautobahnen Gesellschaft* was established as a subsidiary of the *Deutsche Reichsbahn* with a capital of RM. 50 million and complete freedom from federal or state taxes. It had the exclusive right to build and operate the new roads and all subsidiary undertakings such as the provision of petrol-filling stations, repair workshops, unloading and transfer stations, restaurants and advertisements. The company was also given preferential treatment in the operation of passenger and freight transport services. Dr Todt, who organized the autobahnen scheme, was made Inspector-General of German roads in 1934, and he was the final authority in all questions relating to the new system of roads. The *Reichsautobahnen Gesellschaft* consisted of a General Council and Board of Directors serving under the Inspector-General. The former was generally responsible for financial affairs and the latter for business matters. Meetings of the General Council and the Board of Directors were presided over by the Managing Director of the Reichsbahn. Administration was carried out through fifteen main

construction offices (*O.B.K.—Oberste Bauleitungen*) situated at Altona, Berlin, Breslau, Dresden, Essen, Frankfurt-am-Main, Halle, Hanover, Kassel, Köln, Königsberg, Munich, Nuremberg, Stettin and Stuttgart. Local constructional work was supervised by subdivisions of these, known as district offices (*Bauabteilungen*).

The project provided originally for some 4,500 miles of roads, but it was later extended to include a further 2,000 miles. Land along

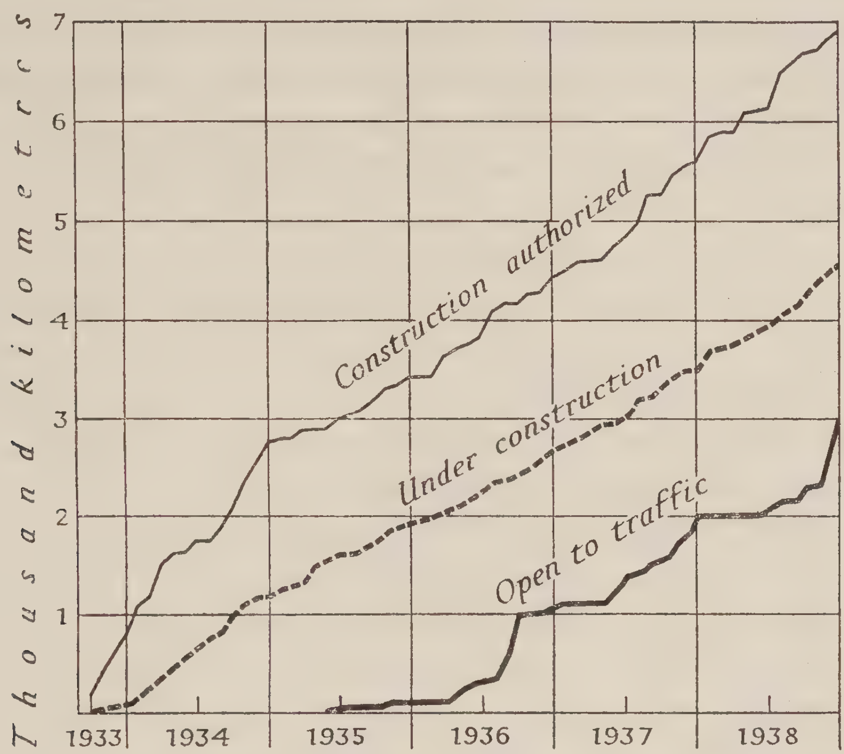

Fig. 108. Progress of the autobahnen scheme, 1933–8

Based on 'Die Kraftverkehrswirtschaft im Jahre 1938', p. 32, Supplement to *Wirtschaft und Statistik*. 19th year, no. 3 (Berlin, 1939).

Steady progress was made after the initial large-scale effort. The slight difference in the form of the 'open-to-traffic' graph is due to the fact that during periods of severe weather, especially in late winter and early spring, the completion and curing of the concrete surfacing was prevented.

the various routes chosen was purchased in the usual manner, but the price was previously fixed by the authorities, and in the case of an owner who refused to sell the company had the right to expropriate; in practice, therefore, no difficulties were encountered in obtaining the necessary land. The first surfacing was commenced in July 1934 between Frankfurt and Darmstadt, and the Frankfurt—Darmstadt—Heidelberg autobahn was the first one opened to traffic. Simultaneously, construction was started on stretches in various parts of the country and they were planned so as to provide an even distribution

of employment. It was estimated that at the end of 1934 over 100,000 workers were employed directly and 250,000 indirectly. At first the labour force included conscripts of the *Reichs-Arbeitsdienst*, but later the Todt Organization was formed to take over the construction of the highways. This organization combined voluntary and conscripted labour on a semi-military basis and it had a nucleus of the most skilled engineers and technicians. The number of workers employed directly in autobahn construction in 1939 amounted to between 150,000 and 200,000 persons. At that date about 2,500 miles of the new roads had been completed, and it was intended that some 650 miles should be added each year. During the war a further 750 miles are believed to have been completed. The constant progress of the scheme is shown in Fig. 108.

Fig. 109. The autobahnen network, 1939

Based on 'Die Kraftverkehrswirtschaft im Jahre 1938', Supplement to *Wirtschaft und Statistik*, 19th year, no. 3 (Berlin, 1939).

The rectangular grid was designed to provide, when complete, easy access between important points in any part of the Reich. D Dresden; F Frankfurt-am-Main; H Hamburg; Hn Hanover; K Köln; Kr Karlsruhe; L Leipzig; M Munich; N Nuremberg; Sn Stettin.

The Autobahn Network (*Fig.* 109)

The plan of the autobahn system is frequently described as a grid, consisting of six principal highways. These comprise two running across the country from north to south, three from west to east, and one from north-west to south-east. The first runs from Hamburg to Hanover, Frankfurt and Basel, following the route chosen by the old *Hafraba* company. The second north-south route runs from Stettin to Berlin, Leipzig, Nuremberg, Munich and so to the Austrian frontier near Salzburg. This route indirectly serves the Brenner Pass. The west-east roads run from Aachen on the Dutch and Belgian frontiers to Köln, Hanover, Magdeburg, Berlin, Frankfurt-an-der-Oder and then to the Polish frontier west of Posen; from Saarbrücken to Frankfurt-am-Main, Erfurt, Weimar, Chemnitz, Dresden, Breslau and to Gleiwitz and Beuthen on the Polish frontier; and from Karlsruhe to Stuttgart, Ulm, Augsburg and Munich. The diagonal road from north-west to south-east follows the line of the lower Elbe and upper Oder valleys from Hamburg to Berlin and Breslau. The network is by no means complete (Fig. 109), but the most complete of the six routes, after those from Stettin to the Austrian frontier and from Karlsruhe to Munich, which are complete throughout their length, are those between Köln and Frankfurt-an-der-Oder, and Frankfurt-am-Main and the Polish frontier at Beuthen. The most backward parts of these two roads are those sections leading to the western frontiers, from Köln to Aachen (partly completed to within 6 miles of Aachen) and from Mannheim to Saarbrücken (the nearest completed section is 27 miles from Saarbrücken and serves Kaiserslautern) and also the section between Frankfurt-an-der-Oder and the Polish frontier. The main gaps on the north-south road from Hamburg to Basel occur between Hamburg and Göttingen, but some progress has been reported on this section since 1939. The Berlin-Stettin route has also been extended beyond Stettin by 67 miles since 1939, but it does not yet reach the Polish frontier. Of the remaining autobahnen two are of outstanding importance—the sections serving the whole of the Rhine valley on the east bank of the river, and the completed highway between the great ports of Bremen and Hamburg, together with its continuation to Lübeck.

The autobahn network is superimposed upon the existing road network of the country (Fig. 113) and is quite independent of it. The new highways begin and end at strategic points on the frontiers of the country and serve directly all the important industrial areas and

regional administrative centres. All cities and other built-up areas are avoided, the autobahnen usually passing at a distance of from two to eight miles from their outskirts, so that high-speed long-distance traffic may avoid the congested streets of all the great cities. Where one or more roads converge on a city, a ring road is built as a by-pass and intersecting points are specially arranged with *Reichsstrassen*, which carry feeder traffic to and from the city.

A complete ring has been planned for Berlin, where three of the most important autobahnen cross, and it is more than half completed. Four main short sections, running north, south, east and west, are intended to connect the circles of *Reichsstrassen* within the capital to the autobahn ring. A special autobahn, however, has been constructed from the western part of the city to the ring; this so-called *Avus* connexion was necessitated by the fact that along this line, that is from the south-west to the heart of Berlin, on the route from the Ruhr to the capital (Fig. 111), passes the heaviest traffic in the capital. For Munich a complete ring is also planned, and for Hamburg a modified ring, involving a large suspension bridge over the Elbe in the western part of the city and docks areas (Fig. 27). Most other towns have half- or quarter-circles which are sufficient to ensure easy connexion between the urban area and the autobahnen.

Technical Features

The most advanced methods of road construction have been applied to the autobahnen since 1934, when construction was first started, although slight modifications have been introduced since that time. It is significant that the scheme was operated by railway engineers rather than by civil engineers, and the autobahnen incorporated several characteristic features of railway lay-out, such as separated tracks and long uninterrupted stretches where the highest speed may be developed, combined with advantages such as special crossings which are not possible in a railway.

The Inspector-General based the selection and survey of routes on considerations of traffic flow, both actual and potential, economic requirements and topographical details. He also decided the basic standards of design, but modifications were made to meet local conditions, and these were controlled from the fifteen provincial offices. The whole design was intended to achieve the highest possible degree of safety, the maximum flow of traffic and the minimum cost for users. The first objective was achieved by the total exclusion of pedestrian, cycle and animal traffic, including the right of access from adjoining

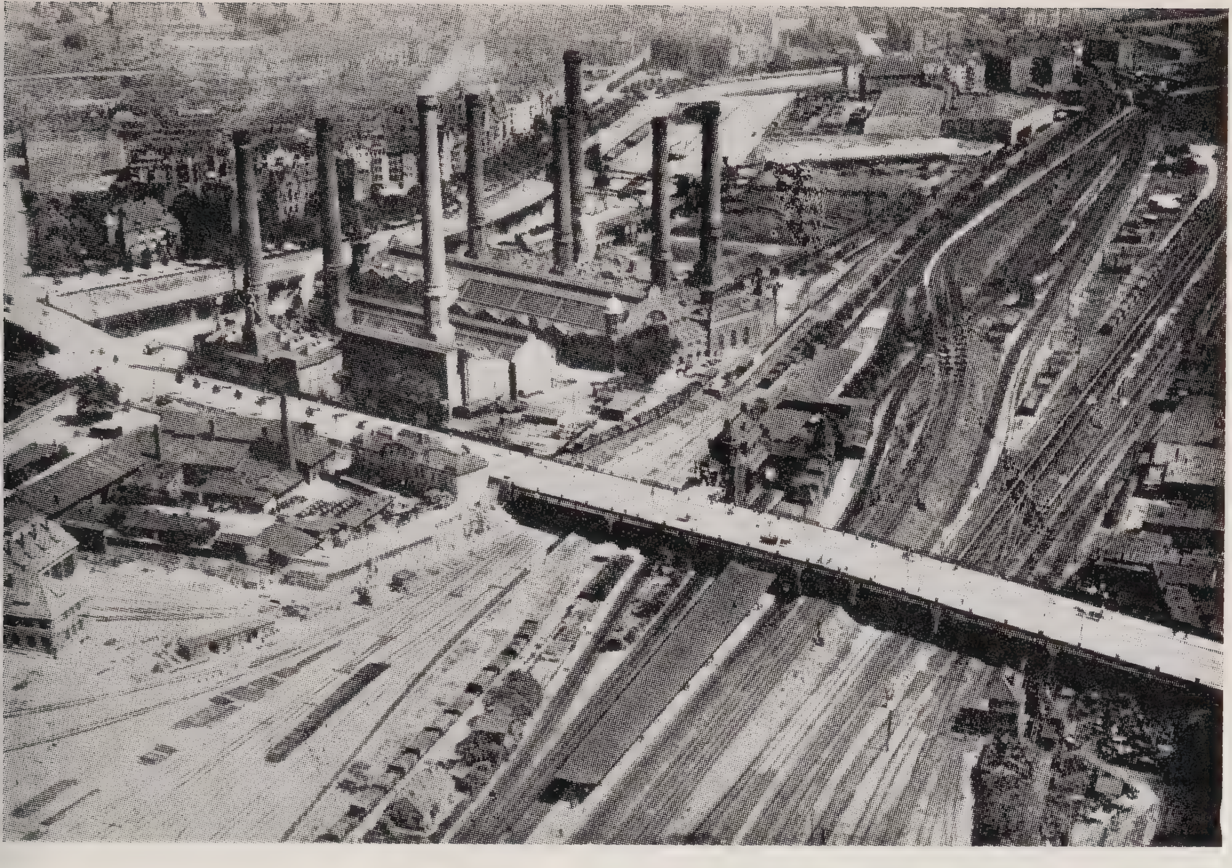

Plate 89. Berlin: Putlitz bridge and Moabit power station, looking east

This bridge carries traffic over the Putlitzstrasse station, railway lines, and Berlin—Spandau Canal (on the left). The left-hand tracks lead to the Lehrter Bahnhof, the right-hand tracks cross over in the background and form part of the circular Ringbahn. The tracks in the left foreground are branches serving the Westhafen, a principal canal port in Berlin. The Moabit power station (81,000 kW installed capacity), is now operated for peak load purposes; coal is delivered by rail or waterway.

Plate 90. Road bridge over the Oder near Fürstenberg

The total length of this bridge is 2,057 ft.; it comprises eleven reinforced arches as well as the central span. The effective width is 29·5 ft.

Plate 91. The land surface and autobahnen of the Bremen—Hamburg—Lübeck region
For key see p. 504.

frontage lands, the complete separation of opposing traffic streams, the elimination of collision points arising from cross traffic by the use of bridges, the control of traffic at road junctions by a systematic layout, and the provision of a clear and simple system of road signals. Maximum traffic capacity and low costs for users were attained by uniform road surfaces of accuracy and permanence, minimizing tractive resistance by easy gradients, providing wide curves and super-elevation whenever necessary and the maximum attainable standards of visibility, and finally, by providing parking and rest spaces off the highway. Many devices were also employed on aesthetic grounds to make each road blend with the terrain through which it passed.

Trial excavations and exhaustive soil tests preceded the actual laying of the foundations. The pattern for these soil tests was determined by a nation-wide survey of soils in the neighbourhood of proposed autobahnen, undertaken in 1933. Risks of damage caused by frost to road surfaces have been reduced to a minimum. Sand and gravel were used to replace the upper strata and other special devices were employed to prevent upheavals due to freezing. The consolidating or filling material was usually taken from the surrounding country. In swampy regions, notably in the morainic country of Bavaria, the unstable layers of soil were removed by blasting out from underneath a previously laid gravel or slag layer. The latter layer then sank on to strata judged to be of sufficient carrying capacity and was finally consolidated.

About 91% of all the surfacing on autobahnen consists of concrete, laid on waterproofed paper which reduces friction to a minimum and prevents premature drying of the concrete through moisture absorption by the soil. These were frequently laid before 1937 on a Telford base, consisting of a solid foundation of hand-packed stones, but this has since been largely discontinued. Of the total length, however, 6% is provided with bituminous surfaces (used on the Bayreuth—Nuremberg and Frankfurt—Darmstadt sections), and 3% with stone setts. Special machinery was used at all stages of construction and included an electrically-operated concrete construction train, stretching the whole width of the track, and moving on rails to ensure continuity in construction. The mixers in this train were replenished by means of a narrow-gauge railway. About 240 yards of concrete were laid in this way per day with a single shift, though higher figures were recorded. The surface of the concrete was finished with great precision to obtain a fine grain, first by machines and then

by hand. The limit of error allowed was 4 mm. in 4 m. (0·16 in. in 13 ft.). In order to prevent the concrete from drying too quickly in wind or sun and to prevent damage by rain, portable tents mounted on the rails were used to cover the surface, and then followed a layer of wet sand, moist straw or woven straw mats. It was usually four weeks or more before the road was opened to traffic.

The standard completed road consists of two carriageways each with a nominal width of 24 ft. 9 in., separated by a central grass strip 16–20 ft. wide. This strip was sometimes planted with trees or shrubs in conformity with the landscape, a practice which helped to prevent dazzle from headlights, or in some cases in forested areas to mask the road from oblique angles in the air. Many strips were planted with wild roses so that a convenient source of hips for the collection of Vitamin C might be established. In the mountainous parts of the country the lanes are either at different levels or completely separated, and this serves a similar purpose in eliminating headlamp glare. Each lane had an inner margin of 15 in. width and an outer margin of 3 ft. 3 in. width forming part of the same surface. These were usually of a different colour (e.g. black asphalt against grey-white of concrete) and served to eliminate dangerous kerbs and were a guide which might be crossed over in an emergency. They also prevented rain-water from penetrating at the edge of the carriageway and so weakening the subsoil. In addition, the centre of each carriageway was provided with a strip of luminous paint to guide drivers during mist and fog. Outer grass margins, 3 to 6 ft. wide and also at surface level, merged as a gentle slope with normal ground level, without drainage ditches. All earth works were moulded in accordance with the landscape. The concrete surface had a normal cross-fall of 1 in 66, without camber, to the outer surface, a slope which, owing to the smoothness of the surface, was sufficient to drain away all rain-water.

The standard design varied according to three main types of country. Gradients and curvature were decided by considering the sight-distance necessary for safe driving, which is a function of the stopping distance of a vehicle. The autobahnen were designed for a speed of 100 m.p.h. requiring a minimum sight distance of about 1,000 ft. in flat country, depending on the gradient. Curves were similarly governed by gradient and speed. The following table summarizes the main requirements in each type of country:

	Lowland or flat country	Undulating or hilly country	Mountainous regions
Maximum speed (m.p.h.)	100	90	80
Maximum gradient	1 in 25	1 in 16·6	1 in 12·5

Gradients over 1 in 50 are infrequent in flat country. One of the steepest autobahn gradients is 1 in 11 on the Munich-Austrian frontier road, with a gradient of 1 in 6 occurring on the connexion to an existing road.

Numerous bridges are used by, or cross over, the autobahnen, because routes are not confined to the valley floors and no roads are allowed to cross at the same level. Many of the viaducts and bridges used by autobahnen to cross valleys and big rivers are very large structures of reinforced concrete. In order to blend with the landscape, however, they are frequently faced with natural stone obtained locally. The bridges are all designed to carry 24 tons* on each traffic lane. Bridges carrying other roads over the autobahnen are usually of concrete with single ramps on either side; access from feeder roads to the autobahnen is achieved by 'T' junctions, which consist of ramps with unequal radii, as cars leaving the autobahnen travel faster than those joining them. The radius of curves for leaving cars is at least 150 ft. but only 75 ft. for incoming cars. The junction resembles a trumpet in shape. Where an autobahn bifurcates and both branches have equally important traffic, an elaborate triangular system has been evolved, e.g. the Mannheim—Heidelberg—Frankfurt intersection (*Dreieck*). A continuous flow of traffic may thus be maintained. The 'cloverleaf' crossing is less favoured in Germany than in the U.S.A. and some other countries, and it is reserved for the crossing of two autobahnen; examples are to be found at Schkeuditz, between Halle and Leipzig, and at Hermsdorf in Thuringia. A 'roundabout' has been employed at Leverkusen near Köln, but usually a modified 'cloverleaf' crossing is provided. The roundabout usually interferes too much with the smooth flow of traffic.

Road Traffic

The National Socialist regime in Germany has been marked by a great increase in the number of motor vehicles in use. No great developments had been apparent in the motor industry before 1933, although the proportion of motor vehicles on the roads had increased. According to vehicle censuses made in 1925–6 and 1928–9 the percentage of vehicles accounted for by horse-drawn vehicles decreased from 54·9 to 26·3, while the percentage of the total traffic by weight carried by horsedrawn vehicles decreased from 50 to 24·2. The

* A 24-ton maximum load carried on two axles, each transmitting 8 and 16 tons respectively, spaced 2·5 m. apart.

intensity of road traffic increased in the same period; the growth of vehicle weight is indicated by the decrease in the share of the smaller vehicle weight categories passing per 24 hours (the 0–200 tons category decreased from 41·6% to 25·6%, while the 201–400 tons category showed an increase of 0·3% and the 401–800 tons category an increase of 7·9%). One of the first measures taken by the National Socialist government was to abolish the heavy taxes on new motor vehicles and so encourage development of motor transport. This fundamental change halted the drop in the numbers of vehicles which occurred between 1929 and 1932 and brought about greatly increased sales and, together with the autobahnen scheme, prepared the way for the considerable technical advances made in the motor industry since 1933. Particularly important has been the application of diesel-engines to motor vehicles, especially goods vehicles. The number of motor vehicles (excluding motor cycles) in 1934 was 690,000 (515,000 passenger cars, 15,000 omnibuses and 160,000 goods vehicles). In 1938, there were 1,707,496 motor vehicles, comprising 1,305,608 passenger cars, 20,792 omnibuses and 381,096 goods vehicles. These figures, however, represented only 1 vehicle to every 44 inhabitants, compared with 1 to 19 for Great Britain, 1 to 19 for France, 1 to 26 for Denmark, and 1 to 37 for Belgium. The Netherlands figure was rather lower than that of Germany, with 1 vehicle to every 59 inhabitants. The number of motor-cycles in Germany in 1938 was 1,582,872, compared with some 790,000 in 1931, which even then was high owing to the low purchase price and upkeep costs of the motor-cycle. The *Volkswagen* scheme represented, in part, an attempt to make it possible for a large number of people of modest income to own a car.

Owing to the considerable size of the country and to the distances separating the leading cities and industrial regions, Germany presents opportunities for the development of long-distance road traffic, which are almost unique in Europe, and which approach the scale of those in the United States of America. The system of autobahnen favoured this type of traffic; the nature of their lay-out has permitted the development of long-distance through traffic with the minimum of interruptions, and with speeds and traffic intensities hitherto impossible on the ordinary first-class roads. Delays on the latter are inevitable in the villages and built-up areas which they naturally serve, and particularly in such a largely continuous urban belt as the Ruhr.

General Traffic Intensity

The third general census of German road traffic, taken in 1936–7, covered a total of 23,426 miles of *Reichsstrassen* with 6,074 census sectors, and 50,027 miles of *Landstrassen I Ordnung* with 12,886 census sectors. There were some 605 miles of autobahnen at the beginning of the census year and about 930 miles at the end, and these were included in the census returns. An examination of these figures showed that the traffic ratio *Autobahn: Reichsstrasse: Landstrasse I Ordnung* was 6·3 : 3 : 1 for numbers of vehicles and 7 : 3·3 : 1 for weight. The summer traffic on *Reichsstrassen* and *Landstrassen I Ordnung* was 50% greater than the winter traffic.

The average traffic per 24 hours for the whole of Germany during the year was 389 vehicles with 889 tons, about 10% being vehicles drawn by animals. The average for *Reichsstrassen* was 679 vehicles with 1,640 tons (only 6% under animal power) and for *Landstrassen I Ordnung* 254 vehicles with 552 tons (16% under animal power). Regional variations naturally depended on the economic development of each region, and in industrial areas such as the state of Saxony the figures are higher than the average—1,178 vehicles with 2,653 tons on *Reichsstrassen* and 399 vehicles with 800 tons on *Landstrassen I Ordnung*, but in purely agricultural areas such as Posen-West Prussia the figures are lower—303 with 745 tons and 172 with 364 tons respectively. The corresponding proportions of horse-drawn traffic are, as might be expected, less in Saxony—2·7% and 8·8%, and more in Posen-West Prussia—14·5% and 31·4%. The heaviest traffic in Germany by numbers of vehicles was observed on *Reichsstrasse* 1 east of Essen, from Düsseldorf to the Rühr, where the census sector recorded 14,828 vehicles with 48,510 tons in 24 hours, some 16–20 times the average for the area. The maximum traffic by weight, 48,971 tons, was recorded in the Hamburg area, but these weights of over 40,000 tons were exceptional.

Road Traffic Accidents

Road traffic accidents showed a steady decrease in Germany between 1936 and 1938, and this may be ascribed in some measure to the growing use of autobahnen by fast through traffic. Such traffic has found safer conditions on the autobahnen owing to their superior lay-out, suitability, and the absence of slow local mixed traffic. In 1937 for the whole country there were 266,394, accidents, involving 7,636 deaths and 174,208 cases of injury. The majority of deaths

occurred among drivers and passengers in vehicles, while of the remainder cyclists and pedestrians were almost equal in proportions. The periodicity of the accidents was similar for each of the years 1936–8 and showed a maximum in the third quarter of the year and

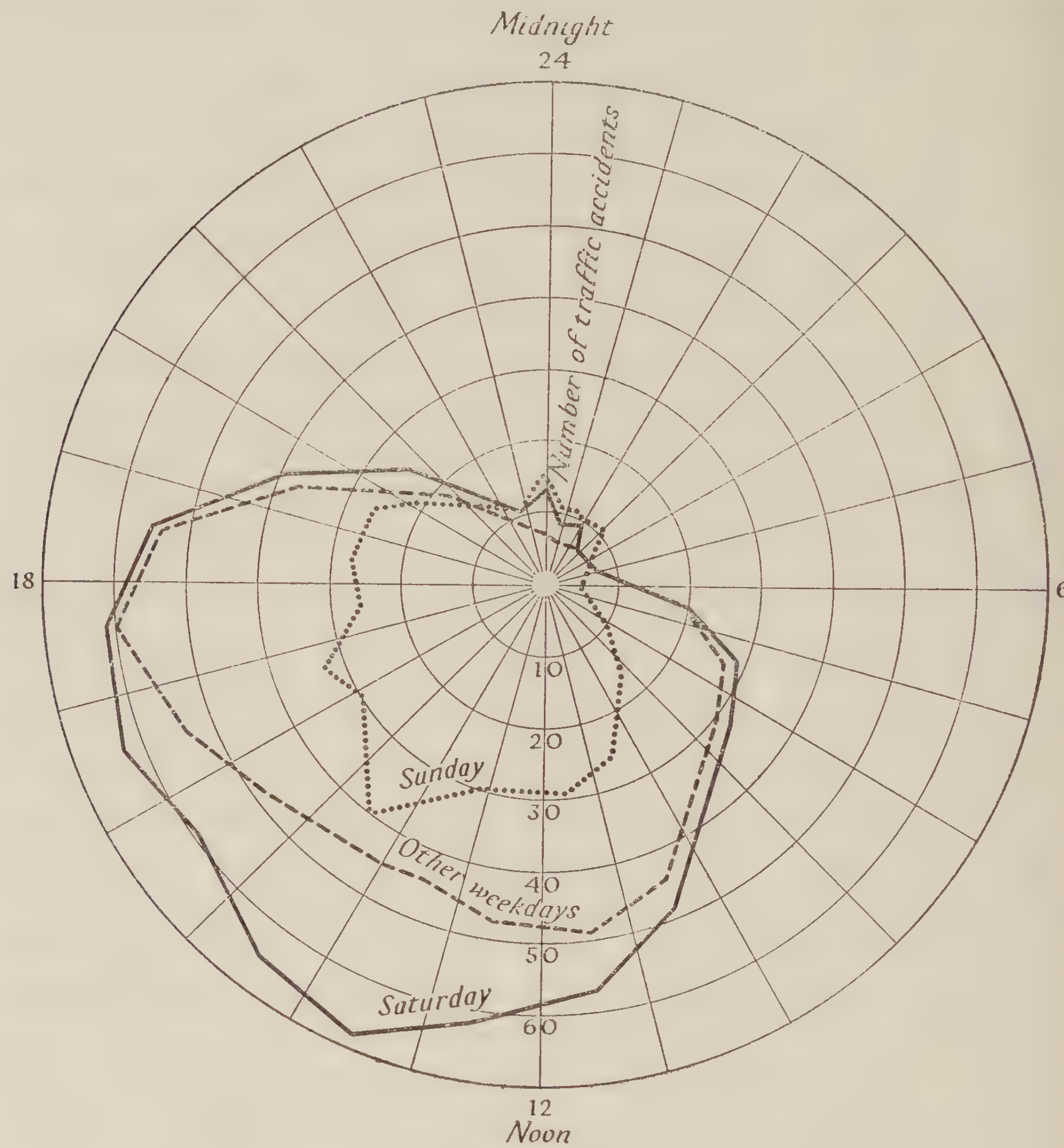

Fig. 110. Road accidents in 1937

Based on 'Die Kraftverkehrswirtschaft im Jahre 1937', p. 31, Supplement to *Wirtschaft und Statistik*, 18th year, no. 3 (Berlin, 1938).

The graphs are obtained by plotting the average number of accidents occurring at particular hours of the different days of the week during the last three months of 1937.

a minimum in the first quarter. The average number of accidents per day in the last quarter of 1937, in which the third highest number of accidents occurred, offers an illustration of road traffic intensity, and shows that accidents chiefly occur between midday and 6 p.m. and especially on Saturdays (Fig. 110).

Competition between Road and Railway

It is impossible to state the exact distance within which motor vehicles operate more profitably than other forms of transport. The range of efficient haulage depends on the condition of highway surfaces, gradients, speed regulations, types of vehicles, wages of drivers and other personnel, vehicle license fees and taxes, and the price of fuel and lubricants. It also depends on weather factors, the rates of freight charged by competitive forms of transport, embargoes on various classes of traffic, and above all, on the kind and value of freight. Owing to its speed, motor transport is principally a rival to railway transport. On short distances of under 40 miles it has been found in both Great Britain and the U.S.A. that up to 75% of the available goods traffic is carried by roads, because of the greater flexibility and dispatch of the road vehicle. Indeed, in the United States road transport is generally superior in speed to railway transport for distances up to 150 miles, but on long-distance operations railway transport is quicker in spite of delays at termini. In Germany no statistics are available for purely local goods traffic, and the statistics relating to long-distance traffic cover only those vehicles operating more than 30 miles (50 km.) from their base. Of a total of 381,000 lorries and tractors registered in 1937, only 24,600 were used for long-distance traffic. Although long-distance road traffic only amounts to 3·1% of all railway traffic (including traffic under 30 miles) by weight of goods carried, it is clear that the long-distance traffic only represents a relatively small proportion of the total road traffic in Germany.

In the decade following 1920 the German railways suffered revenue losses as a result of rapidly increasing road competition. Conflicting figures were, however, issued by the railways and motor interests as to the effect of motor traffic competition on railway traffic, and no reliable data are available. The railways adopted technical measures of various kinds to speed up goods traffic and introduced special rates for passenger travel. The Reichsbahn also came to an agreement with some motor forwarding agents, and was able to eliminate danger of competition by making substantial reductions in cartage rates. The railways paid subsidies to make good the difference between these rates and the cost price of transport. Special rates were introduced by the railways to meet competition in particular traffics and between particular points and they were often conditional on the promise of a minimum dispatch of traffic by the consigner. It was

claimed by the railways that these measures did not constitute discrimination, for they were merely quoting rates corresponding to those of the roads in order to retain traffic. A calculation made in 1930 showed that a reduction in high-class rates sufficient to meet road competition would involve an increase of some 25% in the rates of the lowest classes of freight, such as coal, and 15% in other classes in order to compensate for the loss of revenue.

Government policy in relation to the road-rail problem was first defined by a decree of 1919, confirmed by a law of 1925. This required licences for all motor transport services operating beyond the limits of a municipality. By further legislation of 1931 licensing was introduced for motor goods transport operating over distances of more than 50 km., except in cases of industrial or commercial enterprises operating in their own interests; the obligation was extended to passenger transport. A compulsory minimum tariff was introduced to make motor transport rates correspond to the rates in the three highest classes of the Reichsbahn goods tariff, and a system of way-bills, consignment notes and compulsory inspection was introduced. For their part the railways had to discontinue their special competitive rates. The legislation failed because of the impossibility of maintaining control over the road freight rates. The railways complained of secret price cutting and objected that licensing did not limit the number of road transport enterprises; to meet this complaint a virtual ban on the licensing of new long-distance road goods operators was declared in August 1933.

The National Socialist government approached the road-rail problem armed with the doctrine that German economic interests had priority over those of business. There was to be no transport monopoly, but private undertakings must conform with the state plan for transport. They would be financially self-supporting and there was to be no discrimination in the form of cheaper rates in return for guarantees of traffic, and no rate-cutting. A new law regulating long-distance motor freight traffic was passed in 1935 and under it all hauliers operating outside a radius of 50 km. on behalf of third persons were required to draw new licences and join the Truck Operators' Association (*Reichs-Kraftwagen-Betriebsverband—R.K.B.*). This association, with headquarters in Berlin, fourteen area representatives and seventy-six clearing houses, regulated long-distance road freight transport, organized the distribution of freight orders among members, the invoicing and collecting of bills on behalf of its members to prevent price-cutting, and the compulsory

Plate 92. The land surface and autobahnen of the Frankfurt-am-Main—Mannheim region

For key see p. 504.

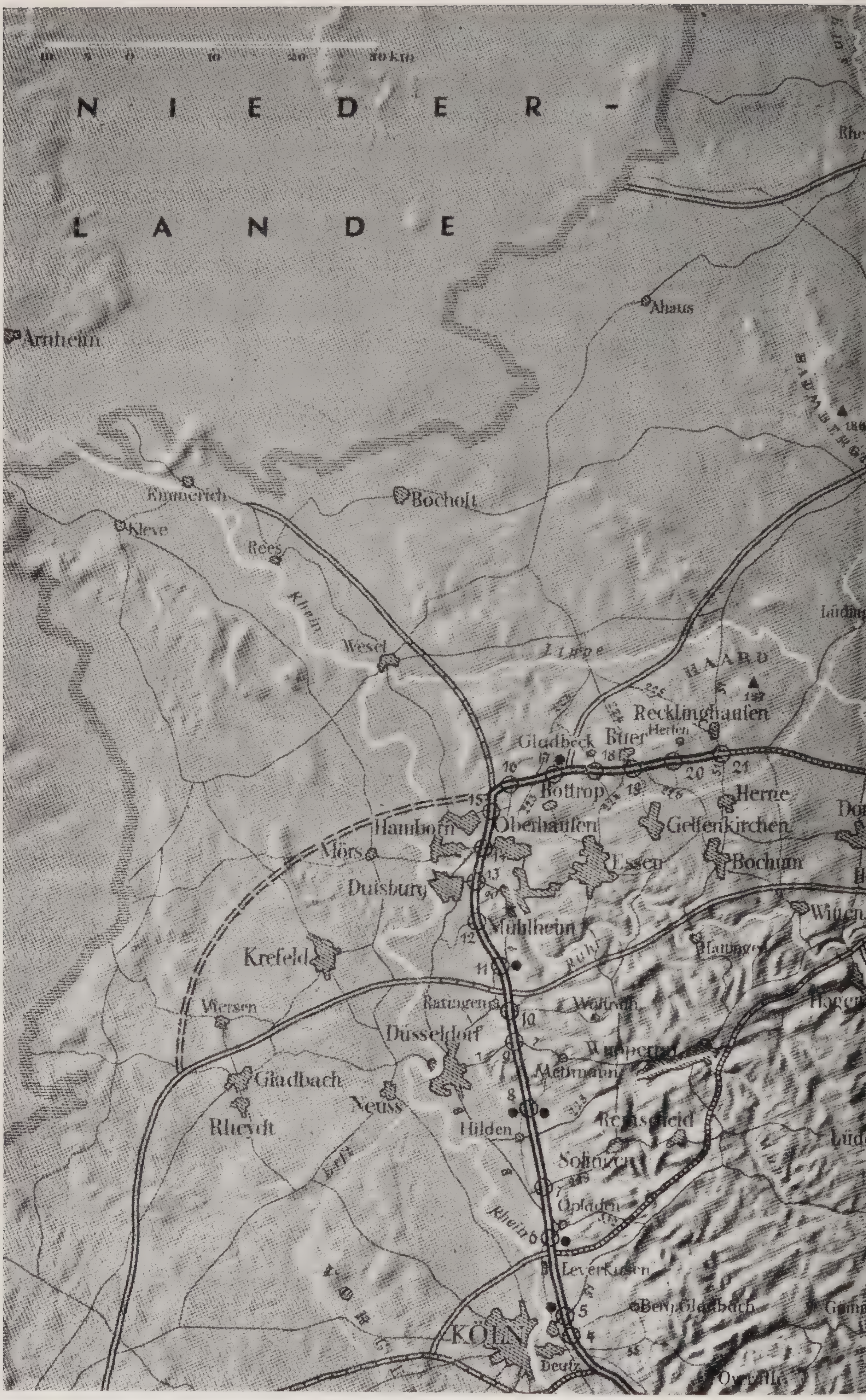

Plate 93. The land surface and autobahnen of the lower Rhine and Ruhr
For key see p. 504.

insurance of all freight. Consigners paid for transport not to the operators but to the association. A vehicle licensed for long-distance traffic was painted blue with a white chain around the body of the vehicle, and carried a board giving the centre on which it was based and its authorization for long-distance traffic. Ancillary traffic, that is traffic of industrial and commercial interests on their own behalf, remained outside the organization, but it was strictly limited to the carriage of goods belonging to the owner of the vehicles, and a close watch was kept on long-distance operators of this type.

Under the law enacted in 1935, the first road transport tariffs were introduced in April 1936, and in the first instance were based on the four highest classes of the railway goods tariff, applied to manufactured goods. Not all of the railway goods tariffs, however, were applied to long-distance road goods transport, especially those including the cheaper bulk goods. Road hauliers made complaints on these grounds and also objected that the special low freight tariffs (*Ausnahmtarife*) of the railways, which had often been introduced to combat road competition, were not applicable to road transport; the latter was consequently penalized. After prolonged discussions between the *R.K.B.* and the Ministry of Transport, which is responsible for motor transport, a new programme, the *Sofortprogramm* or 'immediate programme', was drafted and published in February 1938.

This scheme was intended to remove all obstacles to the development of road freight transport, and the necessary legislative and administrative measures were carried out in the first half of 1938. Complete parity between the rates charged for freight by road hauliers and by the railways was established, and the functions of the *R.K.B.* were extended so as to include 'tramp' operators, who owned only a few vehicles in some cases and suffered under the existing system. Most of the vehicles in the *R.K.B.* worked regularly between specified towns; the 'tramp' vehicles were paid for on a ton-mileage basis and the normal rates were collected from the consigners. Any profits so derived were used to assist non-paying services in the less densely populated areas. A better distribution of orders among members ensured a better utilization of capacity, especially in respect of return freight. For example, the *R.K.B.* and its agencies may now undertake the transport of all the milk for a city. Although in certain instances it was declared that illegal advantages and rebates were granted by some road concerns, the scheme of road and rail coordination achieved some success. Ample traffic was available for each and there was therefore not the strain of severe competition for

diminishing traffic. However, Germany seems to have gone further than most countries in evolving a satisfactory solution to the problem of road and rail competition.

The transport tax imposed on the railways for many years was extended to road transport in 1936. In the case of the railways it equalled 7% of gross receipts from goods transport and 11–16% of gross receipts from passenger transport. The tax amounted to 7% on long-distance road goods transport and 12% on long-distance passenger transport.

Road Freight Traffic

Until 1937 there were no statistical means of gauging the volume of freight carried by road transport in Germany and only an approximate idea of its development could be gained from the figures relating to numbers of vehicles. On the other hand, detailed statistics had for long been available for freight traffic on the German railways and inland waterways. Even so, the regular collection of statistical data on long-distance road transportation only applied to the traffic carried by those vehicles subject to licensing, i.e. those vehicles operating more than 50 km. (30 miles) from their point of registration.

Five main classes of operators were responsible for long-distance road freight transport. They were the Reichsbahn (which also undertook short-distance road transport with its own vehicles), hauliers belonging to the *R.K.B.*, ancillary users or enterprises operating vehicles to carry their own goods (*Werkfernverkehr*), furniture removers, and foreign undertakings. The ownership of the 24,600 trucks and tractors employed in long-distance traffic in 1937, together with 17,816 trailers, was divided as follows:

Owner or service	Trucks and tractors	Trailers
Reichsbahn	946	1,207
R.K.B. hauliers	9,286	10,214
Werkfernverkehr	12,612	5,288
Furniture removers	1,447	1,022
Foreign undertakings	309	85
Total	24,600	17,816

From official sources.

The total weight of traffic carried by long-distance freight operators in 1937 amounted to 15,148,000 tons. This total was almost entirely made up of internal German traffic and the quantity passing over the frontiers in either direction only amounted to some 125,000

tons. Details of the individual commodities are given in the table on p. 484, together with the corresponding amount of each commodity carried by the railways. These figures throw considerable light on the form which road-rail competition has taken, although it must be remarked that the road statistics do not include traffic carried distances of less than 30 miles. At the same time the railway statistics omit quantities of less than 500 kg. (about 10 cwt.), although they include all local traffic as well as long-distance traffic. Since road traffic operates under the more favourable conditions for short distances (under 30 miles) it is likely that the weight of goods carried by road is equal to considerably more than 3·1% of the railway goods traffic. Compared with the weight of goods carried by the German inland waterways, the tonnage carried by road equals just over 11%. On both railways and inland waterways, however, bulk goods such as coal, ores and stone play an important rôle, and these can bear only low freight rates. They are carried by road traffic to a very small extent and then chiefly for short distances. On the other hand, road transport has become a serious competitor for general merchandise and the more valuable commodities. For instance, *R.K.B.* road hauliers received RM. 185 million from the carriage of 8·9 million tons of freight in 1937, averaging RM. 20·87 per ton and Rpf. 7·9 per ton kilometre; the average railway receipts per ton-kilometre equalled Rpf. 3·68.

The most important groups of commodities by weight carried by road in 1937 were industrial products and industrial raw materials other than minerals (55·3%) and agricultural products and foodstuffs (33·6%). Minerals accounted for 5·9% of the total traffic, household removals and returned empties 4·8% and livestock 0·4%. The latter two categories chiefly went by rail. The largest weights for single commodities were recorded for iron and steel products of various types, paper and paper pulp, sawn timber, artificial stone; of these, only paper and paper pulp represent a significant percentage of the amount carried by rail. Of the less important items entering into road traffic, more beer and sugar were carried by road than by rail, while road haulage was an important competitor for the conveyance of animal and vegetable fats and oils, hides and skins, starch and milk products. These all obtain higher freight rates (see page 484).

Statistics relating to average road hauls show that the commodities with an average haul of over 300 km. (186 miles) are leather, earthenware and porcelain, iron, steel and other metals, both in crude and manufactured states, hides and skins, glass and glassware, starch,

Long-distance Road Freight Traffic by Commodities, 1937 (*in thousands of tons*)

Commodity	Weight	Weight carried by rail	Road% of rail
Meat	135	361	37·4
Wheat	168	1,333	12·6
Rye	143	1,238	11·6
Barley	92	1,059	8·7
Vegetables	93	1,205	7·7
Fruit	145	1,284	11·3
Milk products	205	376	54·4
Animal and vegetable fats and oils, excluding butter	403	576	70·0
Flour (wheat and rye)	631	1,329	47·5
Malt	111	277	40·1
Starch	106	175	60·6
Sugar	355	304	116·8
Wine and cider	136	352	38·6
Beer	583	461	126·5
Bran and oil cake	86	1,531	5·6
Mineral oils and residues	268	9,270	2·9
Stone, rough and dressed	123	44,476	0·3
Chalk and gypsum	110	5,624	2·3
Cement and plaster	272	9,610	2·8
Dyestuffs, colours and varnish	112	300	37·3
Other chemical products (excluding fertilizers)	411	7,875	5·2
Hides and skins	127	192	66·1
Yarn	127	309	41·1
Spinning materials	140	1,217	11·5
Timber, rough	138	12,514	1·1
Timber, sawn	906	7,651	11·8
Woodware	141	920	15·3
Paper and pulp	1,102	1,529	72·1
Stone, artificial	881	7,331	12·0
Earthenware and porcelain	82	306	26·8
Glass and glassware	154	775	19·9
Iron and steel bars and ingots	270	7,025	3·8
Iron and steel sheets and plates	266	3,097	8·6
Iron and steel tubes and pipes	193	2,298	8·4
Iron and steel wire	122	1,029	11·9
Other foundry and rolling mill products	289	5,351	5·4
Machinery	196	2,216	8·8
Other iron and steel	619	4,077	15·2
Copper, manufactured	85	200	42·5
Other non-ferrous metals, unmanufactured	163	426	38·3
Total (including unspecified commodities)	15,148	482,224	3·1

From official sources.

edible fats, chemical products, and textile raw materials and semi-manufactures. Those commodities with shorter hauls (less than 186 miles) are mostly perishable goods, particularly foodstuffs—fish, meat, wheat, fruit, coffee, raw tobacco, milk products, and paper and pulp made average hauls of between 250 and 300 km. (155–186 miles), while milk, rye, barley, oats, maize, sugar-beet, cement, and live-stock were chiefly carried distances under 150 km. (93 miles).

The shares of the different types of services operating long-distance traffic were as follows:

Type of service	Tonnage carried		Ton-kilometres	
	thousands	%	millions	%
Reichsbahn	717	4·7	139	4·3
R.K.B. hauliers	8,880	58·6	2,343	71·9
Werkfernverkehr	5,236	34·6	714	22·0
Furniture removers	244	1·6	44	1·4
Foreign undertakings	72	0·5	14	0·4
Total	15,148	100·0	3,254	100·0

From official sources.

The hauliers of the *R.K.B.* (who formed by far the most important class, especially in relation to load per kilometre of route served) and the Reichsbahn road transport services, carried mostly industrial products and industrial raw materials (with 65% and 70·6% respectively), but in the case of the *Werkfernverkehr* operators and foreign undertakings, agricultural products and foodstuffs were of greater significance (45·4% and 56·7% respectively). The foreign undertakings carried more than half the tonnage of goods crossing the frontiers of Germany by road, and a third was carried by *R.K.B.* hauliers (see table on page 486).

The long-distance road freight traffic may be further divided into traffic carried according to distance travelled. Practically one-half of the total amount of freight was carried distances of between 50 and 150 km. (31–93 miles). The various distance categories are shown in the table on p. 486, and they reveal the steady decrease in the weight of traffic carried over long distances. The distances over which the various transport organizations operate reveal that the *R.K.B.* hauliers are the leading long-distance operators, while the Reichsbahn operates a higher proportion than the average of short-distance services. Over three-quarters of the freight carried by *Werkfernverkehr* operators travels distances of less than 150 km.; these operators consist of firms transporting their own goods and therefore have greater local activity. The greatest figures of ton-kilometres occur in two distance categories between 100 and 200 and between 300 and 600 km. The Reichsbahn figures approximate fairly closely to these, but nearly 50% of the ton-kilometres achieved by *R.K.B.* hauliers are recorded for radii of between 300 and 600 km. The concentration of *Werkfernverkehr* traffic as measured by ton-kilometre remains highest in the under 150-km. category.

Long-distance Road Freight Traffic in 1937, according to distance covered

Amount of Freight							
Distance covered, km.	Tons	Percentage of total traffic	Percentage of operator's traffic in each distance category				
			Reichsbahn road transport	*R.K.B.* hauliers	*Werkfernverkehr* operators	Furniture removers	Foreign undertakings
50–100	4,039,627	26·5	36·2	14·7	45·1	25·2	29·3
101–150	3,563,093	23·4	20·8	19·0	31·0	27·3	15·2
151–200	1,925,293	12·7	10·7	13·7	10·7	16·9	28·4
201–250	1,134,952	7·5	6·9	9·2	4·6	10·7	7·0
251–300	986,392	6·5	6·0	8·6	3·0	6·8	3·7
301–400	1,281,047	8·4	7·6	12·1	2·6	7·3	2·2
401–500	1,086,388	7·1	5·8	10·7	1·5	3·0	7·4
501–600	697,346	4·6	3·0	7·1	0·8	1·9	3·0
601–700	341,481	2·2	1·7	3·4	0·5	0·7	3·5
701–800	107,939	0·7	0·9	1·0	0·2	0·2	0·2
801–900	39,678	0·3	0·4	0·4	—	—	—
901–1,000	10,953	0·07	—	0·1	—	—	—
Over 1,000	4,265	0·03	—	—	—	—	0·1

Intensity of Traffic							
Distance covered, km.	Ton-kilometres (thousands)	Percentage of total traffic	Percentage of operator's traffic in each distance category				
			Reichsbahn road transport	*R.K.B.* hauliers	*Werkfernverkehr* operators	Furniture removers	Foreign undertakings
50–100	314,021	9·6	14·5	4·3	26·1	10·9	11·4
100–150	434,113	13·3	13·0	8·8	28·1	18·5	9·3
151–200	329,687	10·1	9·5	8·9	13·6	16·1	24·4
201–250	252,202	7·9	7·9	7·7	7·6	13·2	7·8
251–300	268,073	8·3	8·4	8·9	6·0	10·2	5·0
301–400	444,859	13·7	13·5	15·9	6·6	14·1	3·9
401–500	484,850	14·9	13·3	18·2	4·9	7·5	17·3
501–600	378,998	11·6	8·4	14·5	3·3	5·7	8·0
601–700	219,144	6·7	5·6	8·1	2·4	2·5	11·2
701–800	80,309	2·5	3·5	2·9	1·0	0·8	0·8
801–900	33,357	1·0	1·6	1·2	0·4	0·3	0·2
901–1,000	10,322	0·3	0·7	0·4	—	0·2	0·2
Over 1,000	4,408	0·1	0·1	0·2	—	—	0·5

From: 'Die Kraftverkehrswirtschaft im Jahre 1937', *Wirtschaft und Statistik*, p. 31 (Berlin, 1938).

The regional importance of long-distance road transport must vary considerably, not only in relation to economic circumstances but also to the facilities offered by rail transport. In the table on p. 487 the proportion of road transport compared with rail transport may be used as some indication of this. Thus, while the Ruhr is the second most important area in the country for long-distance road traffic by weight, its railway network is so dense that this traffic only amounts to 1·3% of the total rail traffic. Hamburg and Berlin are areas in which long-distance road traffic is of outstanding importance: in these congested urban areas lorries have an advantage in picking up freight more easily, while both of these great cities have a large variety of industries, producing goods which are more valuable as freight and which are often in small quantities and more easily picked up by lorries. Lower

Saxony, Saxony, Westphalia (excluding the Ruhr), and the Rhine province (excluding the Ruhr) were also important.

The Ruhr had by far the largest share in long-distance road freight traffic with foreign countries; of a total of 81,487 tons entering all traffic districts from foreign sources in 1937, the Ruhr received 22,072 tons, and it dispatched a total of 19,068 out of 41,387 tons. Other important areas, especially for receiving foreign traffic, were the lower Elbe ports, the Rhineland and Berlin.

Rail Freight Traffic and Long-distance Road Freight Traffic in 1937, *by areas* (*in thousands of tons*)

Area	Tonnage received			Tonnage dispatched		
	Road traffic	Rail traffic	Road percentage of rail	Road traffic	Rail traffic	Road percentage of rail
East Prussia, excluding ports	104	6,542	1·6	110	4,083	2·7
East Prussian ports	69	2,200	3·1	59	1,716	3·4
Pomerania, excluding ports	160	6,392	2·5	163	3,392	4·8
Pomeranian ports	132	5,403	2·4	149	2,579	5·8
Nordmark, excluding western Baltic ports	347	7,932	4·4	362	4,211	8·6
Western Baltic ports	280	3,308	8·5	208	1,155	18·0
Lower Elbe ports	676	9,061	7·5	991	5,039	19·7
Lower Weser ports	246	8,038	3·1	275	2,222	12·4
Lower Ems ports	11	2,071	0·5	13	1,241	1·0
Lower Saxony	1,175	26,394	4·5	1,071	23,213	4·6
Upper Silesia	174	13,319	1·3	223	29,593	0·8
Lower Silesia	549	19,010	2·9	662	21,137	3·1
Berlin	1,276	13,060	9·8	496	4,580	10·8
Brandenburg	609	19,543	3·1	767	16,513	4·6
Magdeburg, Anhalt	400	16,850	2·4	477	13,141	3·6
Merseburg, Erfurt	425	19,715	2·2	506	27,939	1·8
Thuringia	280	12,434	2·3	260	10,309	2·5
Saxony	1,304	30,500	4·3	1,183	24,678	4·8
Hesse	825	19,674	4·2	626	20,728	3·0
Ruhr	1,165	78,516	1·5	1,242	114,387	1·1
Westphalia (excluding Ruhr)	832	15,931	5·2	814	14,047	5·8
Rhineland (excluding Ruhr)	1,161	39,238	3·0	1,585	48,738	3·3
Saar-Palatinate	311	21,449	1·4	299	21,452	1·4
Mannheim-Ludwigshafen	180	3,969	4·5	374	4,818	7·8
Baden	411	8,928	4·6	466	9,774	4·8
Württemberg	816	13,732	5·9	677	8,057	8·4
South Bavaria	683	17,615	3·9	593	13,264	4·5
North Bavaria	503	17,663	2·8	416	12,915	3·2
Total	15,105*	458,487	3·3	15,065	464,921	3·2

From: 'Die Kraftverkehrswirtschaft im Jahre 1937', *Wirtschaft und Statistik* (Berlin, 1938).

Note: these areas represent the rail traffic districts or groupings of these districts, referred to on p. 280. The rail figures include foreign trade.

* Excludes 70,800 tons carried under special taxation arrangements by *Werkfernverkehr* operators in the first quarter of 1937.

Passenger Traffic

The first detailed statistics relating to road passenger traffic were collected in 1936. Data were made available for local and for long-distance traffic, and in December 1937 a total of 705 services, aggregating 2,562 miles in length, were in operation on local routes and 4,035, of 54,084 miles, on long-distance routes. The number of omnibuses on short-distance routes was 2,186, with an average of just over 32 seats per vehicle, while on long-distance routes there were 6,393 vehicles, with an average of 27 seats. Using the number of passengers carried as a base, however, the local routes were the more important, accounting for 369 out of 546 million passengers carried on all routes. In comparison with the total road passenger traffic (546 million) the railways in 1936 carried 1,735 million passengers and the street tramways 2,957 million passengers.

Three groups of operators were concerned in road passenger traffic —private undertakings, including municipal operators, the Post Office (*Reichspost*) and the Reichsbahn. The private services were by far the most important and they carried three-fifths of all the passengers, including almost all the local passengers. The *Reichspost* services accounted for most of the remaining passengers, and were nearly as prominent as the private undertakings on long-distance routes:

Number of Passengers carried in 1937 (*thousands*)

Service	Local traffic	Long distance traffic	Total
Reichspost	3,883	78,434	82,317
Reichsbahn	135	2,253	2,388
Private undertakings	364,708	96,691	461,399
Total	368,726	177,378	546,104

From: *Statistisches Jahrbuch für das deutsche Reich, 1938*, p. 235 (Berlin, 1938).

Long-distance traffic was, however, assuming greater importance, and the share of the Reichsbahn was showing signs of increasing as a result of the putting into service of high-speed streamlined omnibuses on the autobahnen.

As might be expected, the greatest number of passengers carried in local services was recorded for Berlin, with nearly half the number of passengers carried by private undertakings. Other important areas were the state of Saxony, the Rhineland and Hessen-Nassau. The state of Saxony was of outstanding importance in long-distance traffic

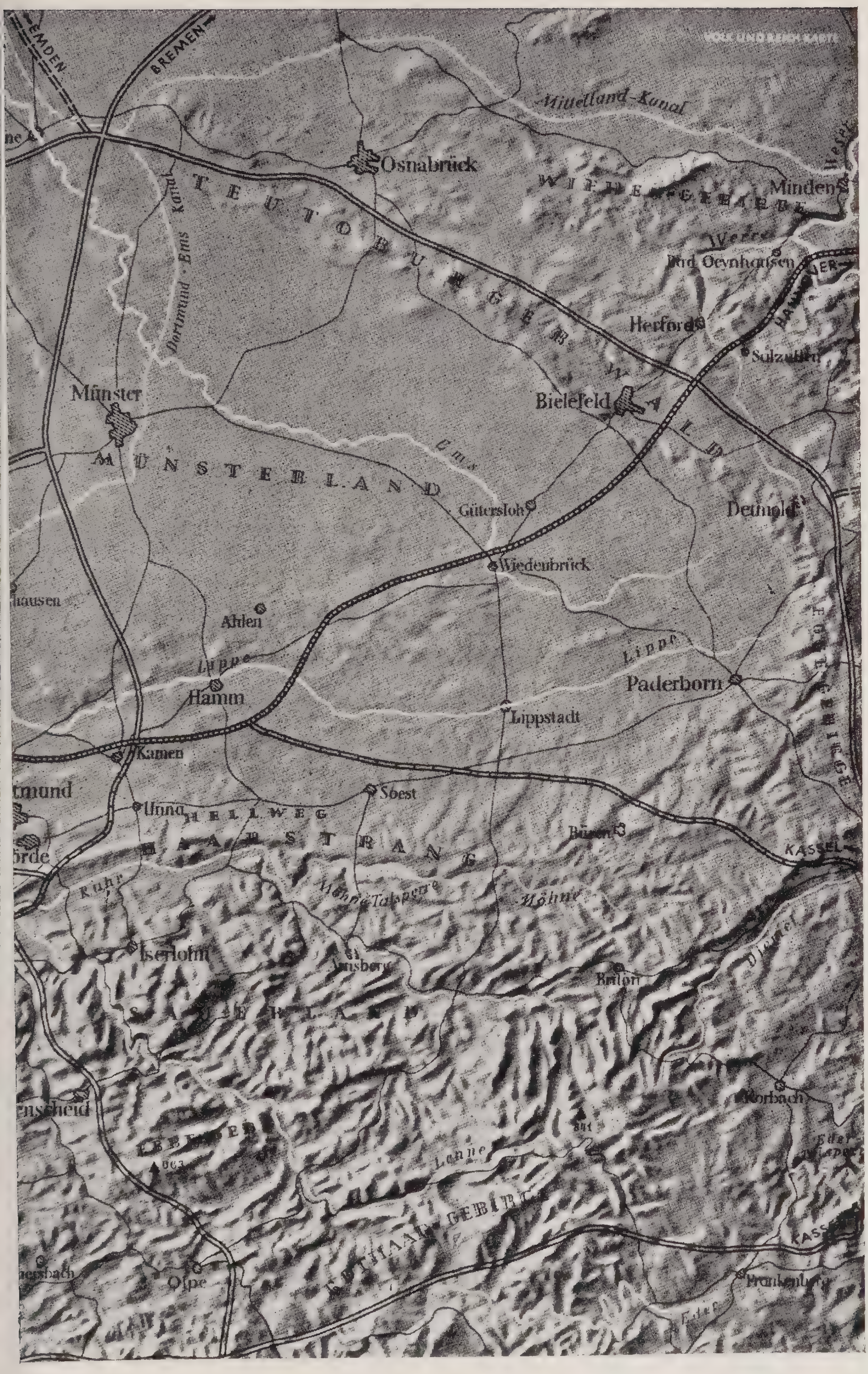

Plate 94. The land surface and autobahnen of the Sauerland and Münster 'Bay'
For key see p. 504.

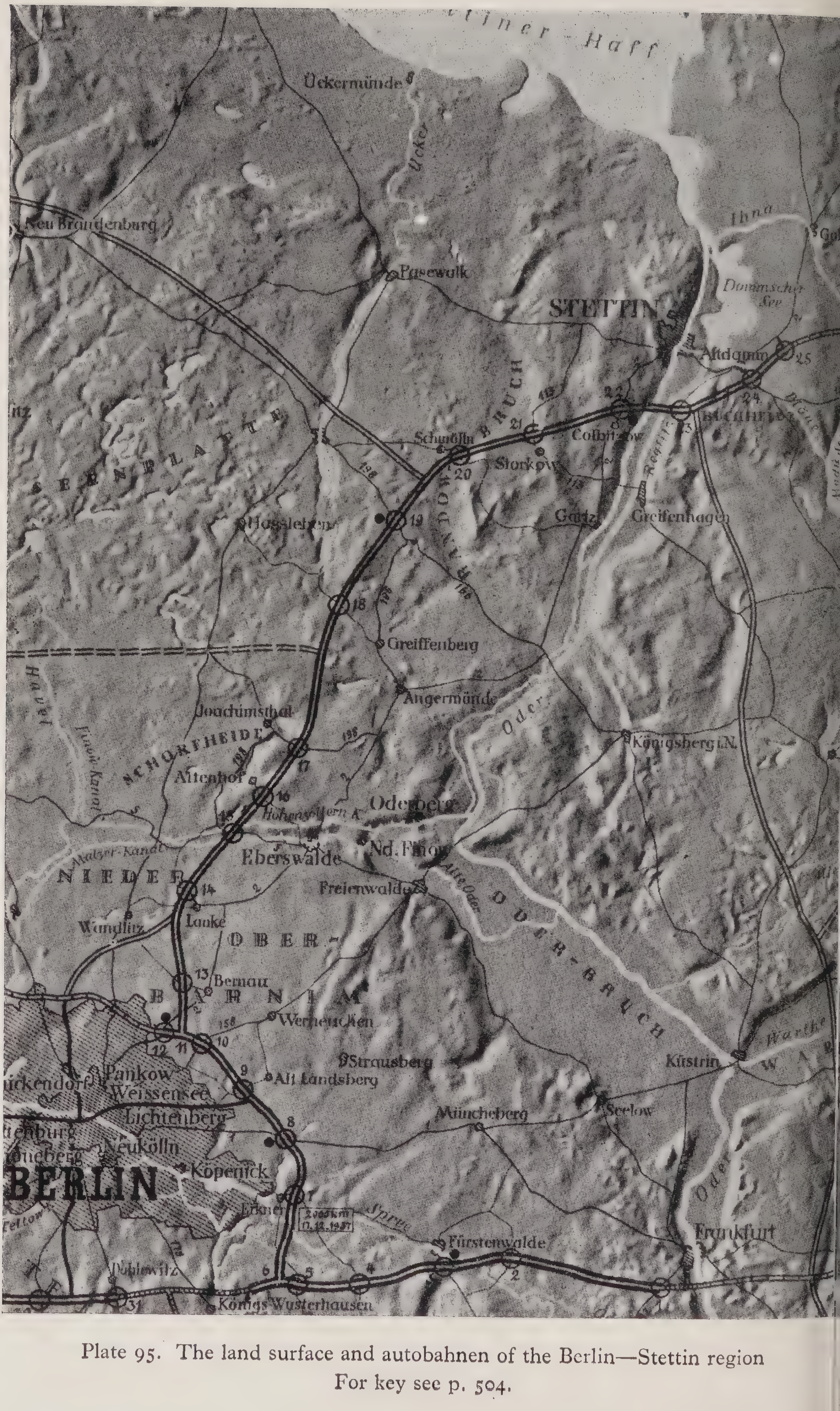

Plate 95. The land surface and autobahnen of the Berlin—Stettin region
For key see p. 504.

for both private enterprises and the *Reichspost*, and the Rhineland and Westphalia were well supplied with private and long-distance services.

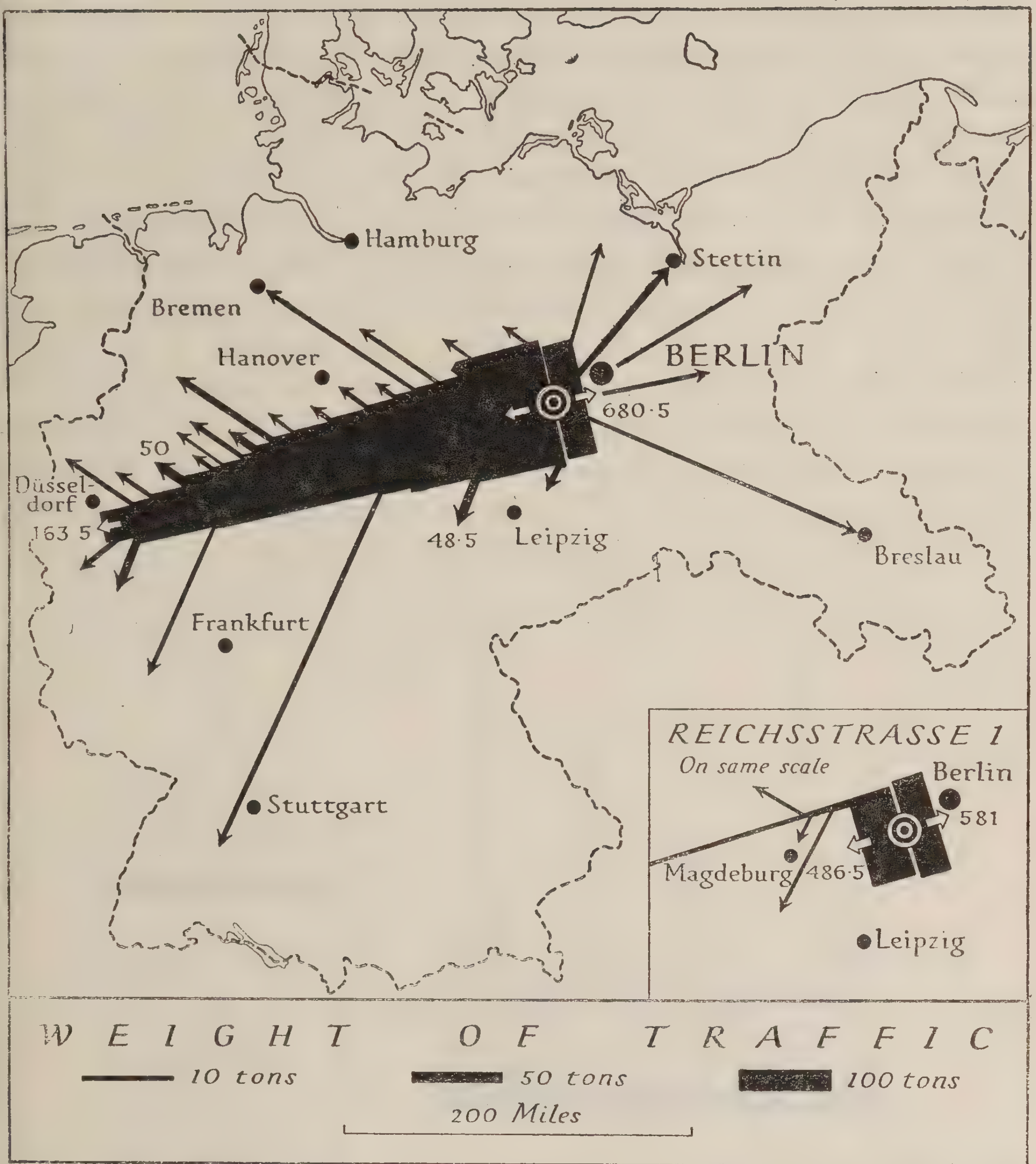

Fig. 111. Weight of load carried and destination of freight vehicles on the Berlin—Ruhr autobahn

Based on a map in *Die Reichsautobahnen*, p. 44 (Berlin, 1938).

The widths of the lines are proportional to the amount of eastbound and westbound traffic passing a census point on one day near Brandenburg. The census point is shown by the black and white circle. The arrows and lines indicate the destination of traffic and not the origin. While the Ruhr is the most important western destination, the highway also carries long-distance traffic (mainly from the capital) to many other points. The eastbound traffic is almost exclusively for Berlin. The inset, showing traffic on the nearby *Reichsstrasse I* on the same day, reveals that this was nearly all local traffic. The census was taken on 23 October 1936 at Werder on the Berlin—Magdeburg—Ruhr autobahn and near Brandenburg on *Reichsstrasse I*.

Traffic on the Autobahnen

Regular traffic censuses have been a prominent feature since the opening to traffic of the various stretches of autobahnen, for they are designed primarily to take long-distance traffic and to leave local traffic to the *Reichsstrassen* and *Landstrassen.* The extent to which traffic on the autobahnen is composed of long-distance traffic is shown in Fig. 111; there is a corresponding concentration of local traffic in the case of a nearby *Reichsstrasse.* Autobahnen have in some cases taken up to 65% of the traffic from neighbouring *Reichsstrassen.* The traffic on the autobahnen varies considerably from one day to another and from month to month, depending on the season, the weather and the stretch of road and its character. The number of passenger vehicles fluctuates particularly strongly and on many stretches it reaches a maximum at week-ends (Fig. 112), with the maximum 'outward' traffic occurring in the early hours of Saturday afternoon and on Sunday morning; the maximum returning traffic is frequently recorded late on Sunday night or during Monday.

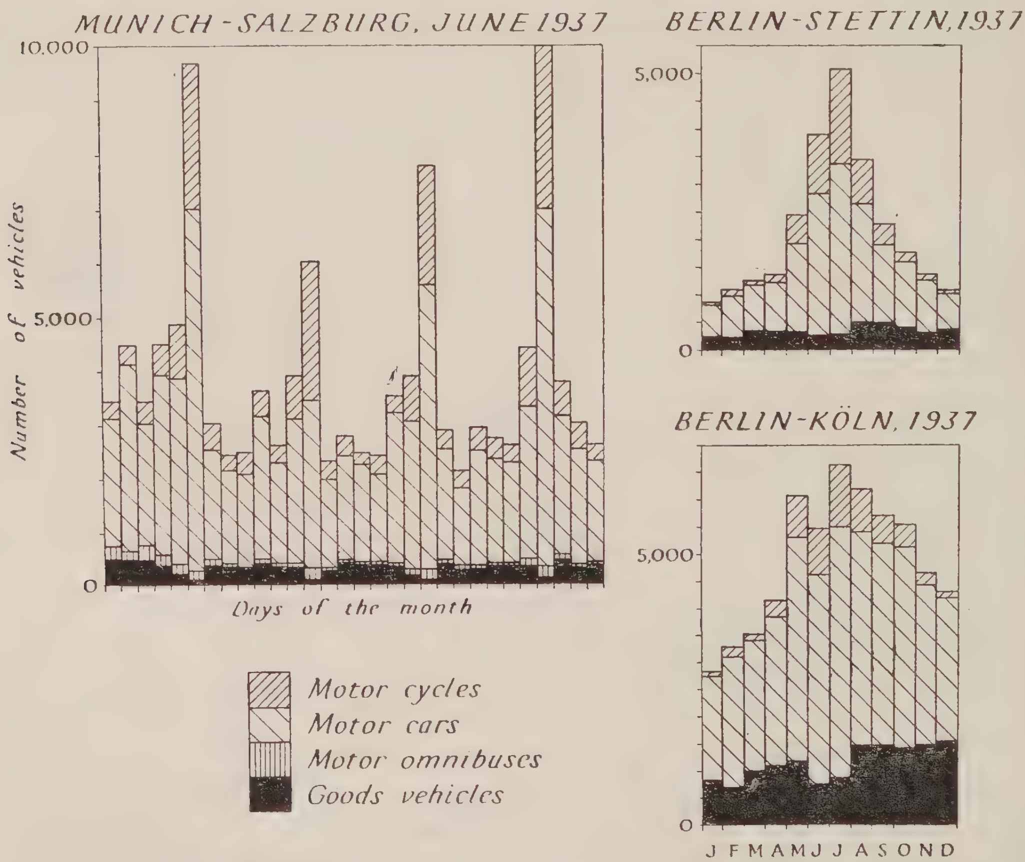

Fig. 112. Daily and monthly fluctuations in autobahn traffic, 1937

Based on *Die Reichsautobahnen*, p. 42 (Berlin, 1938).

The graphs show that traffic fluctuations are largely due to variations in the amount of passenger traffic, both daily and monthly. Freight traffic is generally steady in all three instances. The graphs illustrate the importance of the Berlin—Ruhr—Köln highway for freight traffic.

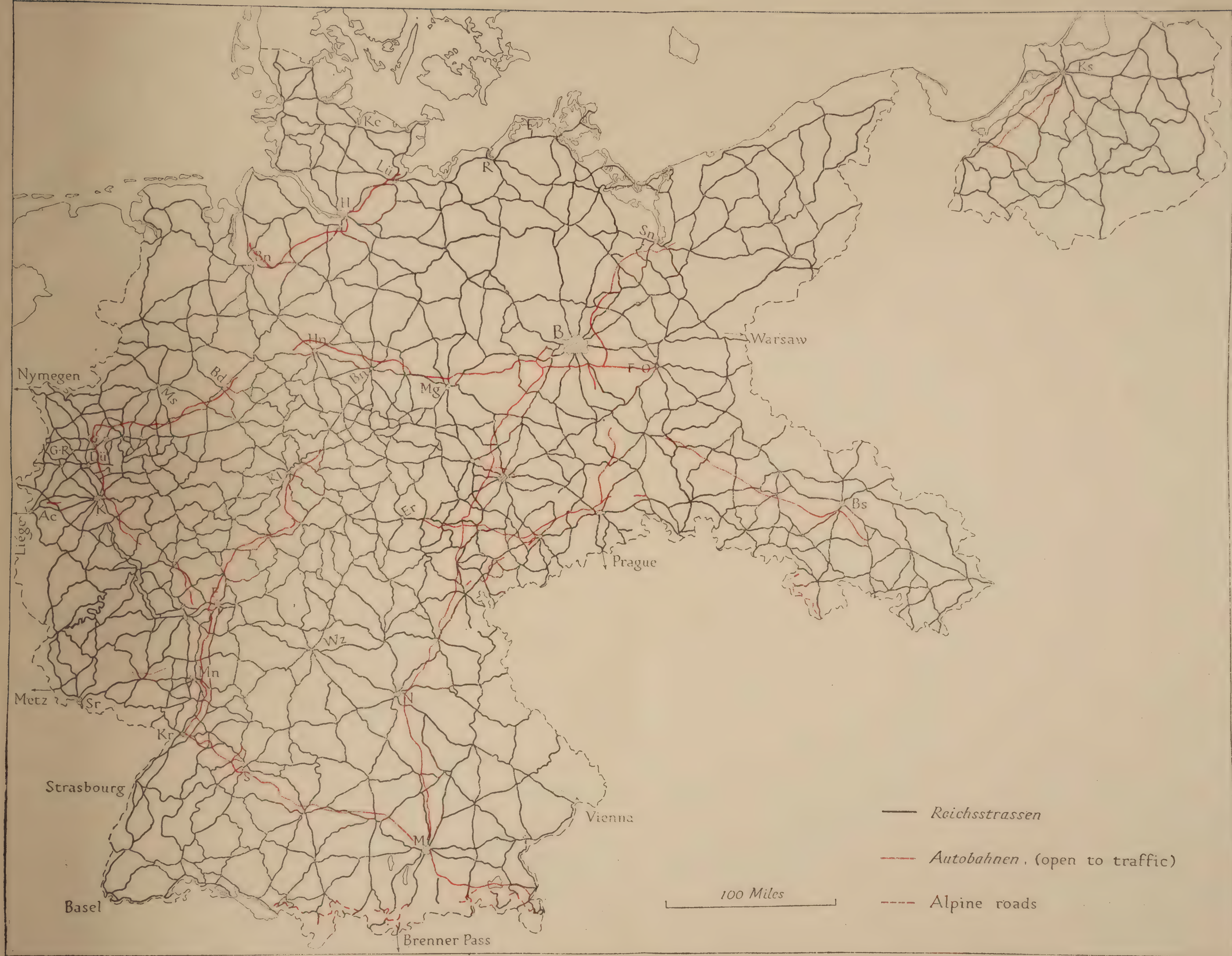

Fig. 113. The main road network, 1939

Based on *Deutsche Automobil-Club Map*, 1940.

Ac Aachen; B Berlin; Bd Bielefeld; Bn (north) Bremen, (south) Brunswick; Bs Breslau; Du Düsseldorf; Er Erfurt; F Frankfurt-am-Main; F-O Frankfurt-an-der-Oder; G-R Gladbach-Rheydt; H Hamburg; Hn Hanover; K Köln; Ke Kiel; Kl Kassel; Kr Karlsruhe; Ks Königsberg; Lu Lübeck; M Munich; Mg Magdeburg; Mn Mannheim; Ms Münster; N Nuremberg; R Rostock; S Stuttgart; Sn Stettin; Sr Saarbrücken; Wz Würzburg. *Landstrassen I Ordnung* and *Landsstrassen II Ordnung* are not shown. Several stretches of autobahnen have since been completed.

Freight traffic variations during the year are mostly small and the seasonal fluctuation of total traffic is less, therefore, when freight traffic is considerable. The Berlin—Hanover autobahn, serving the Berlin—Ruhr route, carries the most important freight traffic of any other corresponding stretch and therefore does not fluctuate in traffic so much as that from Berlin to Stettin, which carries less freight traffic. The freight traffic on the stretches of autobahn between Munich and the Austrian frontier, between Hamburg and Lübeck and between Berlin and Stettin only amounts in summer to 5–10% of the total, but on the Berlin—Hanover and Frankfurt—Mannheim roads it reaches between 40% and 60%. Counts of vehicles frequently gave figures between 12,000 and 15,000 vehicles per 24 hours in both directions, with up to 11,000 vehicles in one direction. In 1938, between 6 and 7 p.m. on Whit-Monday a total of 2,158 vehicles (including only 5 freight vehicles) passed a point near Stuttgart in one direction, along the autobahn from Ulm to Stuttgart. The heaviest traffic records in July 1938 were obtained from the Köln—Duisburg and Karlsruhe—Mannheim—Frankfurt a.M. motor roads, the former having an average near Köln of 9,000 vehicles per day.

The Road Network

The road network of Germany is not characterized by a concentration upon the capital, in contrast to the road networks of France and England. This is largely to be explained on historical grounds, since a large number of the roads were built in states where the influence of Berlin was felt but little. The configuration of the country also limits automatically the attraction of the capital on the road system. Since the main roads link all the chief towns and cities, it follows that the pattern and density of the road network (compare Fig. 113 with the table on p. 492) will reflect the density of population and the economic development of the country. Four main areas may be distinguished in the road network: (i) the North German Plain, (ii) the west-east belt of roads along the northern fringe of the Central Uplands, (iii) the Rhine valley, (iv) the Central Uplands, Württemberg and Bavaria.

The North German Plain

The eastern part of the North German Plain is dominated by Berlin, which is the focus of eleven *Reichsstrassen* converging upon

Densities of Road Networks in Administrative Regions, 1936

Region	Miles			Density in miles per 100 sq. miles			
	Reichs-strassen	*Land-strassen I Ordnung*	*Land-strassen II Ordnung*	*Reichs-strassen*	*Land-strassen I Ordnung*	*Land-strassen II Ordnung*	Total
East Prussia	1,554	2,823	3,409	11	20	24	55
Brandenburg	1,781	2,570	2,859	12	17	19	48
Pomerania	1,381	2,226	2,134	9	15	14	38
Grenzmark Posen-West Prussia	259	576	542	6	13	12	31
Lower Silesia	1,314	2,766	3,104	13	27	30	70
Upper Silesia	508	1,062	943	14	29	25	68
Saxony (province)	1,461	3,223	2,936	15	33	30	78
Schleswig-Holstein	742	1,596	1,197	12	27	20	59
Hanover	2,032	3,875	4,167	14	26	28	68
Westphalia	1,367	2,666	3,074	18	34	39	91
Reg.-Bez. Kassel	733	1,483	2,259	17	35	54	106
,, ,, Wiesbaden	505	933	1,675	22	40	73	135
Rhineland	1,936	3,808	3,455	21	41	37	99
Bavaria	3,834	7,327	6,722	13	25	23	61
Saxony	1,007	3,069	4,072	17	53	70	140
Württemberg	1,138	4,228	3,732	15	56	50	120
Baden	1,021	1,901	2,203	18	33	38	89
Thuringia	829	1,222	787	18	27	17	62
Hesse	528	1,356	1,314	18	46	45	109
Mecklenburg	660	1,022	785	11	17	13	41
Oldenburg	315	831	847	15	40	41	96
Brunswick	339	681	750	24	48	53	125
Anhalt	121	333	306	14	37	34	85
Lippe	101	202	398	22	44	86	152
Schaumburg-Lippe	23	44	96	18	34	74	126
Saar	112	433	291	15	58	39	112
Hamburg	24	48	22	8	17	8	33
Bremen	24	24	43	24	24	43	91
Total, including Lübeck	25,675	52,354	54,155	14	29	30	73

Based partly on *Statistisches Jahrbuch für das deutsche Reich, 1938*, pp. 238–9 (Berlin, 1938).

it from all sides (Fig. 114). In the western part of the plain close networks serve the ports and industries of Hamburg and Bremen, while cross-country routes link these centres with the Baltic ports of Lübeck and Kiel and with the Danish frontier. Elsewhere the plain is provided only with a sparse network of roads; large gaps in the road network in the south-west and west correspond to the great expanses of heath and moor country, such as the Lüneburg Heath south of Hamburg and north of Brunswick. The condition of some of the main roads in this area is only fair, while some crossing the heath are bad and impassable in winter. Road communications are particularly difficult in the crescent-shaped area north and north-

west of Berlin, where there are many lakes, resulting from the damming of streams by terminal moraines and other glacial material. Many of the roads have to be embanked to prevent flooding from swollen lakes. At Plön, for example, in Schleswig-Holstein, the main Lübeck—Kiel road runs on an isthmus between three adjoining

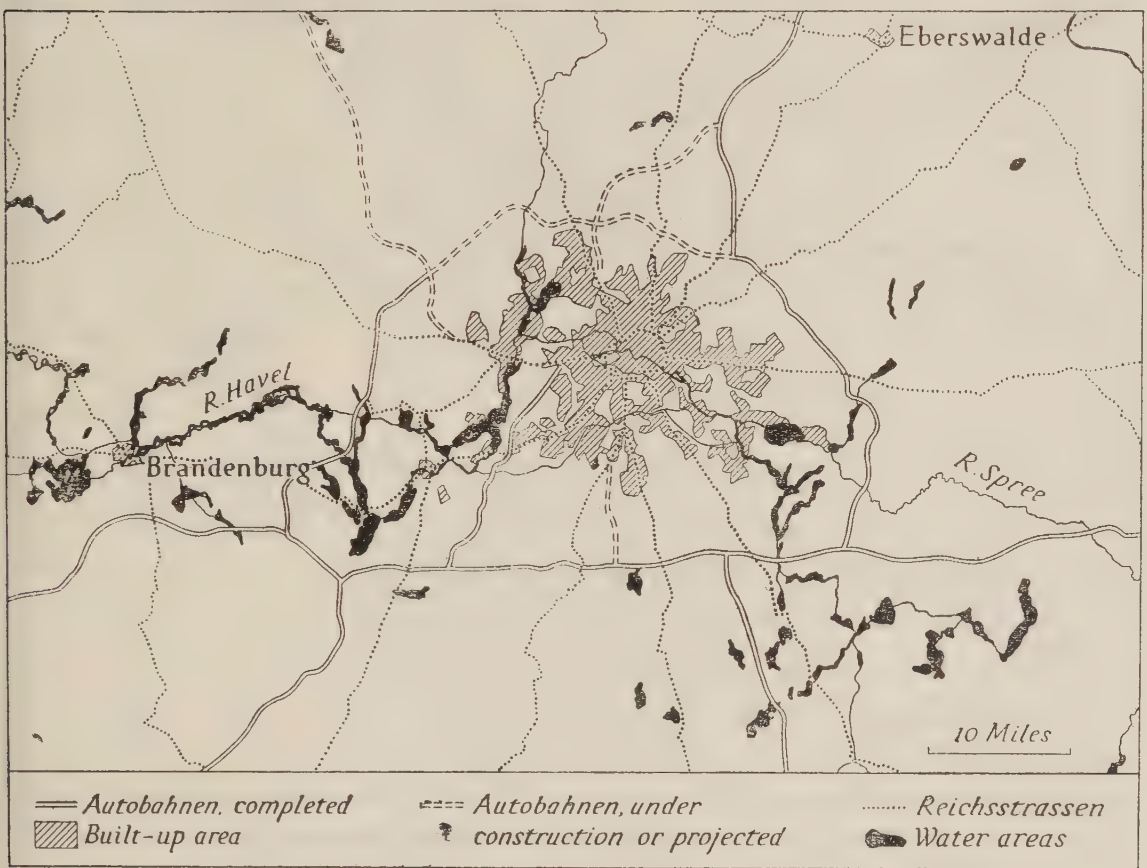

Fig. 114. The main roads of the Berlin area

Based on G.S.G.S. Series 4346, Germany, 1 : 250,000, Sheet N.53.

The ring autobahn, at a distance from the outskirts varying from 2 to 8 miles, and the converging *Reichsstrassen*, are shown clearly.

lakes (Fig. 115). Further west, embankments have to be provided on roads crossing the polderland round the Elbe and Weser estuaries, as on the Bremen—Hamburg autobahn and the new bypass to Wilhelmshaven. The road densities for Mecklenburg, Brandenburg, West Prussia and Pomerania reflect these poor conditions, and the fairly low figure for East Prussia, too, is related to a similar geographical background. Local sources of heavy road metal are lacking, and their absence has always presented a problem for road builders.

The Northern Fringe of the Central Uplands

This belt of country has long provided a route from east to west,

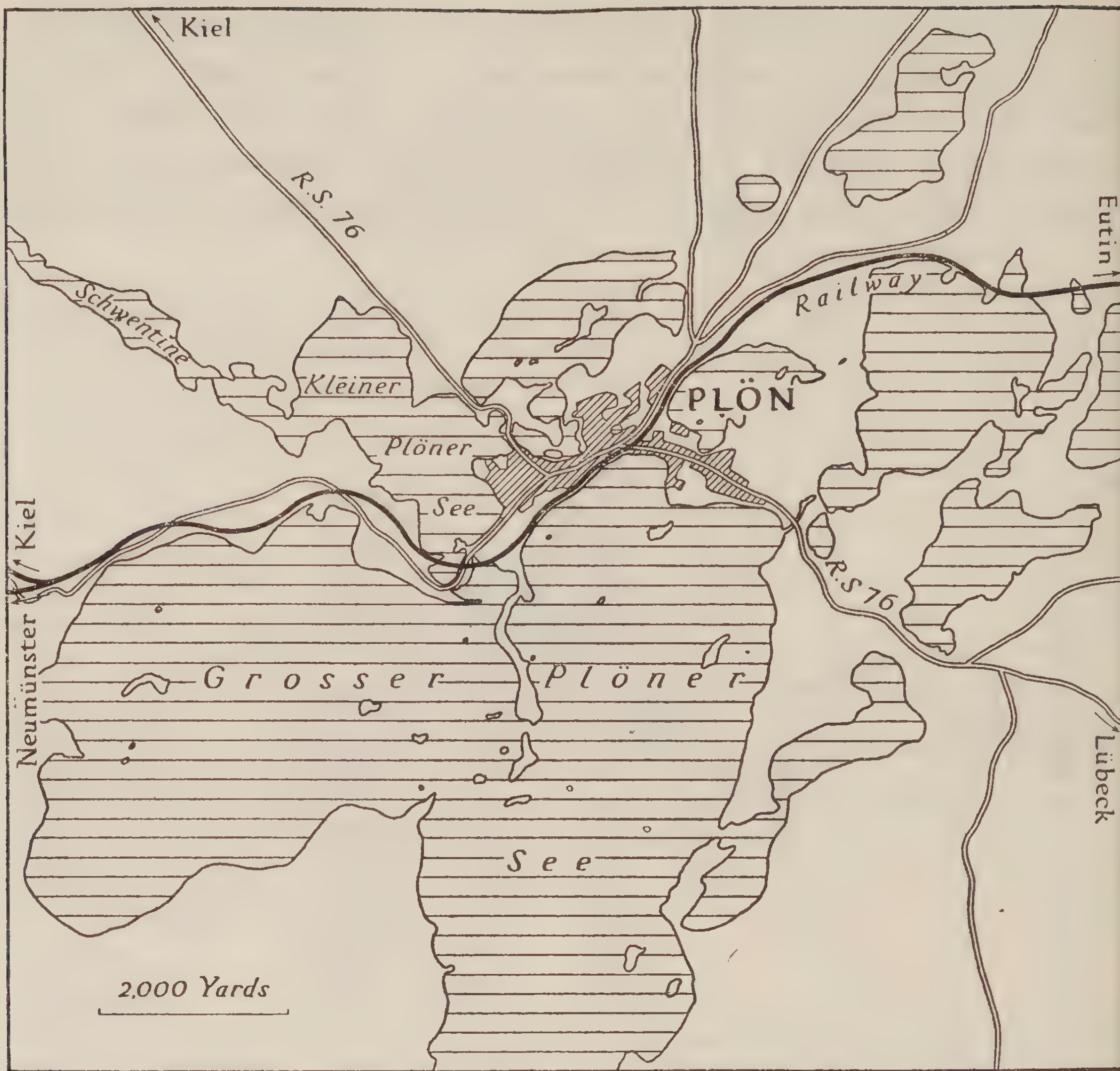

Fig. 115. Roads at Plön (Schleswig-Holstein)

Based on G.S.G.S. Series 4414, Germany, 1 : 25,000, Sheet 1828.

In North Germany the roads encounter many glacial lakes and marshy areas. The main roads converging upon Plön are obliged to use embankments in order to avoid flooding. (Only one of these roads—from Kiel to Lübeck—is a *Reichsstrasse.*)

Away from the main bodies of water the land surface is marked by many small patches of water and bog: railways and settlements, no less than roads, are restricted by topographical features. The railway shown is a single-track line.

confined between the moor and marsh of the plain to the north, and the forests of the Harz Mountains and Central Uplands to the south. The route is economically one of the most important in the country to-day, for it links the Ruhr with the Halle—Leipzig and Thuringian Basin lignite industrial area; Berlin is linked to this belt by several major roads, and farther east the traffic artery is continued through the great industrial area of Saxony, along the Czechoslovak frontier into the Breslau basin. In the last area textiles form a high percentage of the goods carried by road. A chain of important towns is found

along the whole route from the Ruhr—Bielefeld, Hanover, Brunswick, Magdeburg, Halle, Leipzig and Dresden. At Hanover, in particular, and also at Brunswick and Magdeburg, converge the most important roads crossing the northern lowlands from Bremen, Hamburg, the Baltic ports and Berlin. Leipzig has nearly as many roads centred upon it as Berlin, for roads converge here to cross Central Germany to the Rhine or to Bavaria. The agricultural utilization of the fertile loess belt along the route, together with the establishment of a variety of industries, has provided some of the densest road networks in the country. Thus the region east of Bielefeld in Lippe and the area between Leipzig, Chemnitz and Dresden in the state of Saxony have the densest networks of any part of Germany, and Brunswick and Schaumburg-Lippe also have dense networks.

The Rhine Valley

The Rhine Valley is the most important north-south traffic artery in Germany and indeed in central Europe. The Ruhr is a meeting place for the two great traffic routes in Germany and has a very dense network of roads serving the whole urban and industrial area. The close road network of the Rhine valley, as in Wiesbaden and Hesse, for example, is an inheritance from the past and many of the present roads follow the routes taken by Roman roads. The present roads tend to have a north-south orientation with a road on each bank running parallel to the Rhine on a terrace some distance back from the river and above the level of flooding. Tributary roads connect the chief towns to the west and to the east and serve the fertile agricultural districts along the river valley. The Rhine gorge, which separates the two main parts of the Rhine valley, the Köln 'bay' and the Upper or Rift valley with their dense road networks, causes the parallel roads to follow the banks of the river closely. The chief obstacles to road communication are to be found in the steep slopes bordering much of the valley—in the Wupper valley, the upper Ruhr, the gorge section, the Odenwald and the Black Forest. The river itself is the major obstacle and though many lateral roads cross the valley, only 22 permanent bridges are provided for them between the Dutch frontier and Basel (see table on p. 499 and Figs. 117 and 118). No bridge at all is available in the Rhine gorge between Koblenz and Mainz. The growth of industry in the valley, especially at Karlsruhe, Mannheim-Ludwigshafen, Mainz, Köln (with the Ville lignite field) and Düsseldorf as well as other centres, has greatly

enhanced the importance of roads in the transport system. Köln is the great road focus of western Germany, while Frankfurt is a centre of roads radiating to Bavaria and Central Germany, Saxony and Berlin; not far downstream from Frankfurt, Mainz dominates a fairly easy crossing of the Rhine.

The Central Uplands, Württemberg and Bavaria

This area has a fairly homogeneous pattern of roads, with densities about equal to the average for the whole country. The Central Uplands are crossed from north to south by two main routes: (*a*) from Hanover up the Leine and Fulda valleys to the road centre of Kassel, where there is a dense network of roads, or to Eisenach, and leading thence south-west to Frankfurt or south to Würzburg, and, (*b*) from Leipzig to Gera, Nuremberg and Munich. Both of these routes are important north-south links with the major east-west route along the northern edge of the Central Uplands and it is significant that both are followed by autobahnen as are the other important arteries. The north-south route from Leipzig (and Berlin) carries through traffic to Austria and the Brenner Pass from the industrial area of Saxony. The plains of Bavaria are characterized by an even distribution; roads are centred upon Munich, the great road focus of southern Germany and the jumping-off point for crossing the Bavarian Alps. Other old towns such as Würzburg, Nuremberg, Augsburg, Ulm and Stuttgart also form foci for converging roads, which run fairly straight. Gradients are not excessive in the morainic plain of the Bavarian Foreland.

Note on the Roads round Hanover

In detail, the road network reflects conditions of relief and soil and differences in settlement pattern and density of population. Interesting contrasts are apparent, for example, in the country round Hanover (Fig. 116). This map of the Hanover district covers two of the most highly contrasted types of terrain in Germany, the infertile heath and moor country, and the productive *Börderland*, which contains some of the richest agricultural land in the country. The line of the autobahn marks approximately the northern limit of the *Börderland*, an area of flat undulating arable land, mostly under sugar beet and wheat, developed on rich loam soils derived from loess. It is devoid of hedges or ditches and the close network of major and minor roads serves a dense population living in compact nucleated villages at the road junctions. The open country of the

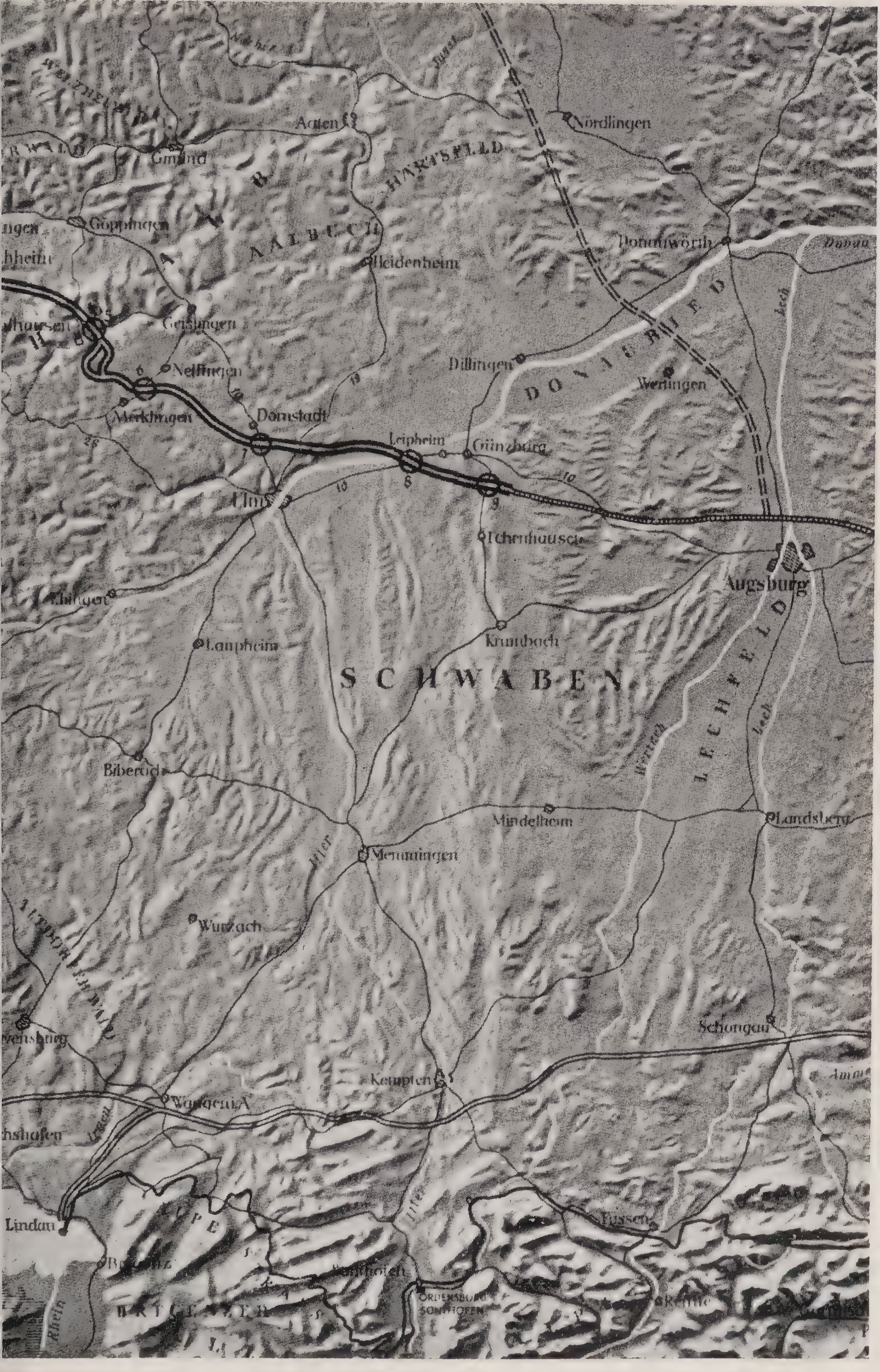

Plate 96. The land surface and autobahnen of the Swabian Foreland

The western part of the *Alpenstrasse* in the Allgäuer Alps is shown by a thick black line. For key to other symbols, see p. 504.

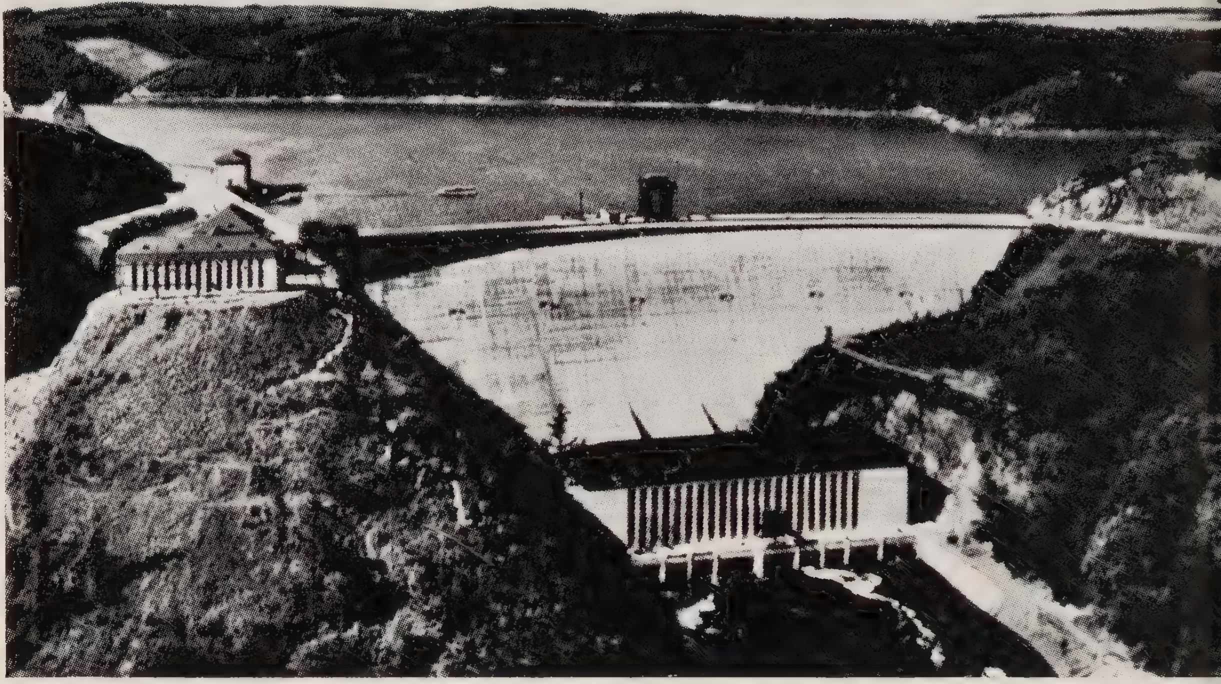

Plate 97. The Saaleburg (Bleiloch) dam, R. Saale

This reservoir, the largest in Germany, was completed in 1929. Together with the Hohenwarthe reservoir, lower down the river, it impounds a volume of water almost equal to the annual flow of the river. The water is used to maintain the level of the Saale, and thus of the Elbe. The height of the dam is 215 ft., and the reservoir has a capacity of 205 million tons. The power station has an installed capacity of 40,000 kW.

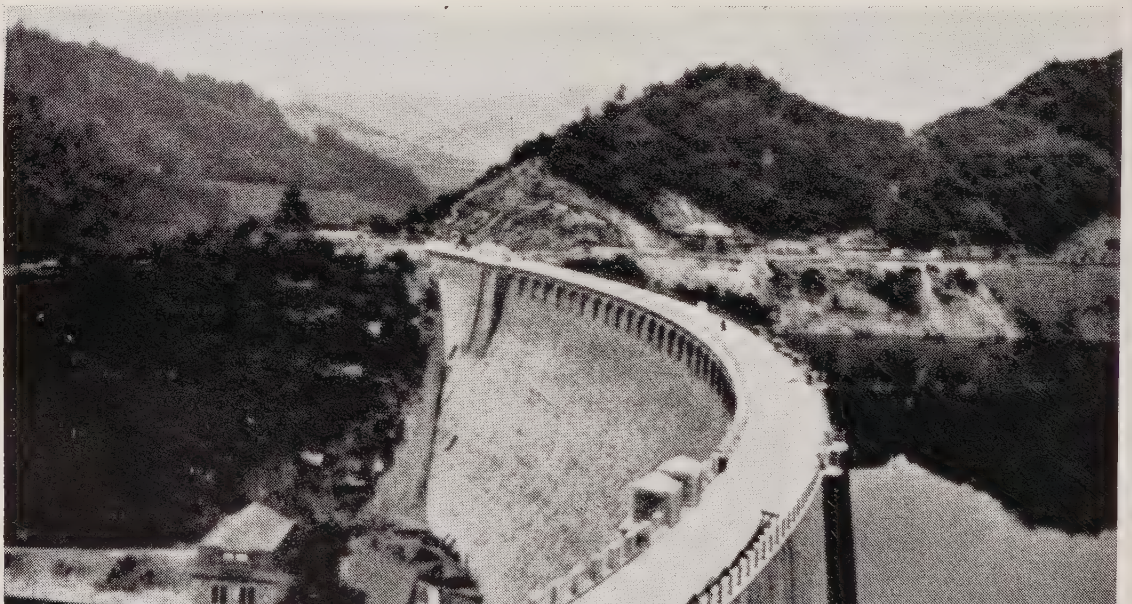

Plate 98. The Deichow dam, R. Bober

This reservoir contributes to the maintenance of the level of the Oder, of which the Bober is a tributary, and provides power as well; the installed capacity is 72,000 kW.

Fig. 116. The roads around Hanover

Based on G.S.G S. Series 4416, Central Europe, 1 : 100,000, Sheet N.4.

The double line represents the Berlin—Ruhr autobahn, the thick lines main roads (including both *Reichsstrassen* and *Landstrassen*). North of the autobahn lies the poor sandy *geest* country of the North German Plain, comparatively sparsely settled; to the south are the fertile loamy soils of the *Börderland*, with a dense agricultural population. A belt of towns lies along the junction of the two types of soil. This contrast bears, at first glance, no striking parallel in the road network, although the network is appreciably closer in the south. The map illustrates one of the possible drawbacks incurred in using a road classification, for, in fact, the roads of the *Börderland* south of the autobahn are largely in good condition, but even *Reichsstrassen* in the areas of sandy heath and marsh to the north are often in bad condition.

Börderland has always provided an important east-west routeway, and it is significant that to-day the autobahn from the Ruhr to Berlin follows this route along the northern edge of the Central Uplands. Hanover itself stands where this east-west route is crossed by the north-south route (to Frankfurt and the Rhine) of the Leine valley, which can be traced in a wide curve to the north-west of Hanover. The town is not only a local focus of routes but a centre of converging roads from all the North German Plain. In the south-west corner of the map the marked paucity of main roads reflects the hilly terrain of the Deister, a Cretaceous limestone outlier of the Weser Bergland. North of the fertile *Börderland* wide areas are largely under heath, often with low-lying bog. There are extensive pine plantations, and to the west of Celle is a small area of sandy *Geest* which is largely afforested with conifers. The network of major and also secondary roads is much wider; bog and marsh account for many of the gaps. Settlements are widely scattered and are situated in clearings in the wood and heath. The roads round Celle are in some cases impassable, especially in winter, and are not as good as those in the *Börderland*.

Road Bridges over the Rhine

The twenty-two road bridges over the Rhine in Germany are mostly very large structures, and exhibit considerable variety in type. The oldest existing bridge built purely for road traffic dates from 1881–5; five were constructed in the years immediately prior to 1939, and three have been built since that date. The longest bridge is the *Hermann Göring* at Neuwied, and the second longest is the *Adolf Hitler* at Krefeld—Uerdingen; the latter, however, is the more important for general traffic.

(For details of railway bridges over the Rhine, see pp. 499–502.)

Road Bridges over the Rhine

No. on Figs. 117, 118	Location	Routes served	Length ft.	Width of roadway ft.	Water gap ft.	Construction	Maximum load capacity (tons)
2	Fort Blücher, Wesel	Netherlands (Venlo) to Münster and Ruhr, etc.	1,700	25	950	Iron and steel lattice girder bridge. 6 spans, including 3 flood spans on banks. Built 1914–18	23
4	Duisburg, Ruhrort, Homberg (*Admiral Scheer* bridge)	Belgium, Netherlands (Venlo) to Ruhr, etc.	2,085	38	1,610	5-span iron and steel parallel lattice bridge. Masonry abutments and piers. Built 1905–6, reinforced 1928–30	23
5	Duisburg-Hochfeld, Rheinhausen (*Admiral Graf Spee* bridge)	Belgium, Netherlands (Venlo) to Ruhr, etc.	2,700*	?	1,300*	Iron and steel parallel lattice bridge. Built 1934–6	23
7	Krefeld—Uerdingen (*Adolf Hitler* bridge)	Belgium, Netherlands (Roermond), Gladbach-Rheydt to Ruhr, etc.	2,900*	40	610	Steel suspension bridge, 12 spans. Built 1933–6	24
8	Oberkassel, Düsseldorf (*Skagerrak* bridge)	Belgium, Netherlands, (Roermond), Gladbach-Rheydt to Düsseldorf and Ruhr, etc.	2,211	66·5	1,214	Two main through-arch spans on masonry piers (lattice girder arches with tie rods). 3 western and 1 eastern approach spans of steel arch deck type. Built 1896–7, rebuilt 1926–7	20
10	Neuss, Düsseldorf	Belgium, Aachen to Ruhr, etc.	2,560	62	1,050	Three central spans, cantilever truss type imitating curve of link suspension bridge. Two reinforced concrete river piers. Four approach spans each end. Built 1927–9	23
11	Köln, Mülheim	Belgium, Aachen to Ruhr, etc.	2,300*	?	1,000*	3-span iron and nickel steel suspension bridge. East bank direct approach, west bank low-lying, with 6 minor spans. Built 1926–9	Over 24

No. on Figs. 117, 118	Location	Routes served	Length ft.	Width of roadway ft.	Water gap ft.	Construction	Maximum load capacity (tons)
12	Köln, Deutz (*Hohenzollern* road and rail bridge)	Belgium, Aachen to Ruhr, etc.	1,450*	40*	1,100*	3 adjacent iron and steel structures on common piers; 2 downstream are rail with double tracks. Upstream is road bridge, carrying tram traffic. Three spans, arched lattice girders and tie rods. Built 1908–10	23
13	Köln, Deutz	Belgium, Aachen to Ruhr, etc.	1,410	36	1,115	3-span iron and nickel steel suspension bridge, 2 stone access viaducts. Built 1913–15, widened since.	25
15	Rodenkirchen (nr. Köln) Autobahn bridge	Aachen—Köln to Duisburg—Berlin autobahnen	2,400	2 × 24	1,200	3-span suspension bridge, parallel lattice work. Reinforced concrete towers and abutments. Completed 1941	?
16	Bonn	Local routes in Rhine valley	2,815	23	1,200	3-span iron and steel bridge. One steel arch through span, and two steel arch decked spans. Three flood spans on west bank and seven on east bank. Built 1896–8	23
18	Neuwied (*Hermann Göring* bridge)	Secondary crossing of Rhine, Neuwied—Koblenz, Neuwied—Bonn	3,265	28	North branch 433, south branch 670	Two spans over river, one over island in between, and one over railway on south bank. Iron and steel lattice girder bridge. Built 1934–5	24
20	Koblenz (*Pfaffendorfer* bridge)	Luxembourg, Trier, Mosel valley to Giessen, secondary crossing	1,000*	39	920	3-span bridge; double-hinged steel arches with lattice girders. Roadway superimposed on these. Erected as railway bridge 1862–4, rebuilt for road 1933–4	24

24	Mainz, Kastel	Main route Paris—Metz to Frankfurt-am-Main—Leipzig—Berlin	1,800*	35	1,540	5-span steel arch (double-hinge) deck bridge. Built 1881–5, widened 1931–4	24
25a	Gernsheim	On secondary road, Eich to Gernsheim. Joins main Mainz—Mannheim and Frankfurt—Mannheim roads	1,510*	32*	950*	10-span bridge, 2 high long spans in centre, low and short spans at each end. Central portion has steel lattice girder superstructure. Built since 1939	?
27	Worms (*Ernst Ludwig* bridge)	Main road from Saarbrücken to Würzburg	2,441	21	984	3 river spans, steel arch deck type; 13 concrete and stone flood spans on approaches. 2 towers at each end of bridge. Built 1897–1900	24
28	Ludwigshafen-Mannheim road and rail bridge	One of the most important bridges over Rhine. Paris—Metz—Saarbrücken to Frankfurt, etc., by autobahn	1,240	N. roadway, 21·3; S. roadway, 24·6	820*	3-span steel lattice girder bridge. Road bridges have separate superstructures from and are distinct from rail bridge to south; two common stone river piers. Small viaduct carries approaches at each end	N. roadway, 16; S. roadway, 24
30	Speyer road and rail bridge	Alternative main road: Saarbrücken to Würzburg, or to Heilbronn and Stuttgart	1,847	20	771	2 main steel lattice girder spans; 7 flood spans. Road and rail bridge separate parallel structures, common central pier. Built 1935–8	24
32	Wörth, Maximiliansäu-Karlsruhe road and rail bridge	Main route Metz—Saarbrücken to Karlsruhe, Stuttgart and Munich. Major alternative route to Mannheim bridge. Access at Karlsruhe to Frankfurt and Munich autobahnen	1,000*	26	700*	2-span lattice girder bridge. Road and rail bridges separate superstructures on common pier east of centre of river. Built 1935–8	24

No. on Figs. 117, 118	Location	Routes served	Length ft.	Width of roadway ft.	Water gap ft.	Construction	Maximum load capacity (tons)
35	Kehl, old bridge	Two of most important bridges over Rhine. Join Strasbourg and Kehl and first permanent road bridges over Rhine below Basel	787·5	27·2	770*	4-span lattice girder bridge, built 1895–7. Partly destroyed by French 1940, repaired since then	24
36	Kehl, new bridge	Main road Paris—Nancy—Strasbourg—Ulm—Munich	1,070*	27	770*	9-span bridge constructed since 1939, some 700 ft. upstream from the old bridge. Wide span east side	?
39	Markt—Kembs Barrage road bridge	Carries secondary road connecting villages of Markt and Kembs over Kembs locks and barrage	?	16	600*	Reinforced concrete bridge, four piers in river bed	?

* Approximate.

From official sources.

War-time Conditions, 1939–44

Owing to the need of economising in labour, fuel and lubricants, civilian traffic on German roads was cut down considerably after the outbreak of war. In practice, road transport facilities became available for essential war purposes only. They were subject to a rigorous system of controls, and as a rule vehicles were not allowed to operate beyond a limited radius.

Further work was carried out on the autobahnen, and it is believed that during the war more than 750 miles were built. In 1939 considerable stretches remained to be constructed (Fig. 109); since that date progress was made towards completing the stretch between Hamburg and Göttingen, for example, and the section beyond Stettin towards East Prussia was extended during the war towards the Polish frontier.

A special development since 1939 was the adoption of stretches of existing autobahnen and main roads to form a system of 'through' roads for military purposes. To this end improvements were carried out in order to reduce the number of bottlenecks, level crossings and detours. The roads formed the basis for working out March Orders. The network crossed the Reich from east to west and from north to south, and made connexions with the road systems of France, Belgium, the Netherlands, Denmark, Poland and the U.S.S.R. Control was in the hands of Military District Headquarters (*Wehrkreis-Kommandantur*).

Bibliographical Note

1. A short but useful general source on German roads is Siedentop, I., 'Geographie der deutschen Strassen', *Petermanns Mitteilungen*, vol. 83, pp. 97–102 (Gotha, 1937).

2. Numerous articles on road construction, bridge construction, snow clearance, etc., with illustrations and diagrams, are contained in many German technical periodicals such as *Die Strasse*, *Der Strassenbau*, *Die Bautechnik*, *Deutsche Bauzeitung* and *Verkehrstechnik*.

3. A very wide range of literature covers the subject of *Autobahnen*, and includes especially articles in technical journals. The following publications, issued by the Inspector-General's department, are devoted specifically to them and include a series of thirteen very useful maps in relief: *Vier Jahre Arbeit an den Strassen Adolf Hitlers* (Berlin, 1937) and *Fünf Jahre Arbeit an den Strassen Adolf Hitlers* (Berlin, 1938). Technical features are dealt with in *Die Reichsautobahnen* (Berlin, 1938), issued by the same department. *The Motorways of Germany* (Cement and Concrete Association, London, 1939), covers similar ground, while an article by Brodrick, A. H., 'The New German Motor Roads', *The Geographical Magazine*, vol. VI, pp. 193–210 (London, 1938), provides a useful summary.

4. Details of road and rail competition in Germany are obtainable in Wohl, P.,

and Albitreccia, A., *Road and Rail in Forty Countries* (Oxford, 1935), and more recent information is contained in Brig.-General Sir H. Osborne Mance, *The Road and Rail Transport Problem*, pp. 74–81 (London, 1940). Information on the traffic of the *Autobahnen* is derived from official publications on these roads.

5. Statistics are chiefly found in the *Statistisches Jahrbuch für das deutsche Reich* (Berlin, annually), and in *Wirtschaft und Statistik* (Berlin, monthly). The latter contains a section on road traffic and special supplements were issued for 1937 and 1938.

6. The official road map of *Der Deutsche Automobil-Club* (*D.D.A.C.*) is the *Strassenzustandskarte von Deutschland*, scale : 1 : 100,000 (München, 1939); it shows all *Reichsstrassen* with official numbers and the condition of each road, together with the *Autobahnen* and the chief secondary roads. The *Autobahn Atlas*, issued in 1939, contains useful detailed maps.

7. For medieval German roads see the *Kulturgeographie* sections in Kretschmer, K., *Historische Geographie von Mitteleuropa* (1904). A list of books and articles on roads and road traffic both in the country as a whole and in separate regions and states is given in Dahlmann-Waitz, *Quellenkunde der deutschen Geschichte*, ed. Haering, H., vol. 1, p. 177 (9th ed., 1931). General studies of road history are: Gasner, E., *Zur deutschen Strassenwesen von der ältesten Zeit bis zur Mitte des 17en Jahrhunderts* (Leipzig, 1889); Huber, F. C., *Die geschichtliche Entwicklung des modernen Verkehrs* (Tübingen, 1893); Lotz, W., *Verkehrsentwicklung in Deutschland seit 1800 bis zur Gegenwart* (Leipzig and Berlin, 1920); Thimme, P., *Strassenbau und Strassenpolitik in Deutschland . . . 1825–35* (Stuttgart, 1931).

There are numerous regional studies. See, for example: Beuth, 'Über die Fortschritte des Chausseebaues im preussischen Staat während der Jahre 1816–29', *Verhandlungen des Vereins zur Beförderung des Gewerbefleisses in Preussen*, vol. 9, 1830; Cassinone, H., *Geschichtliche und technische Entwicklung des Strassenwesens in Baden 1810–20* (Karlsruhe, 1925); Gerbing, W., *Die Pässe des Thüringer Waldes in ihrer Bedeutung für den innerdeutschen Verkehr und das deutsche Strassennetz* (Halle, 1904); Grabo, W., *Die ostpreussische Strassen im 18en und 19en Jahrhundert* (1910); Hartung, G., *Die bayerischen Landstrassen, ihre Entwicklung im 19en Jahrhundert und ihre Zukunft* (Leipzig, 1902); Jahr, E. R., *Entwicklung des Verkehrswesens in Thüringen im 19en Jahrhundert* (Leipzig, 1903); Sälter, F., *Entwicklung und Bedeutung der Chaussee und Wegebaus in der Provinz Westfalen . . . 1815–44* (Marburg, 1917); Schellenberg, A., *Die Entwicklung des Landstrassenwesens im Gebiet des jetzigen Regierungsbezirks Merseburgs* (Halle, 1929); Spiess, K., *Entwicklung des Strassenwesens in Mittelfranken* (Würzburg, 1924).

Explanation of Symbols on Plates 91–6 (facing pp. 473, 480, 481, 488, 489, 496)

The thick double lines represent autobahnen which were open to traffic in 1938, with circles to indicate the position of junctions; the double lines with close cross-lines are autobahnen under construction; the double lines with open cross-lines indicate autobahnen the construction of which had been authorized. The double broken lines represent extensions planned for the future, and the fine double lines show the remaining roads of the basic network. The single lines show *Reichsstrassen*, with their classification number. The network of autobahnen has been extended since 1938.

The plates are based upon the official publication, *Fünf Jahre Arbeit an den Strassen Adolf Hitlers* (Berlin, 1938). Scale: about 1 : 1,000,000.

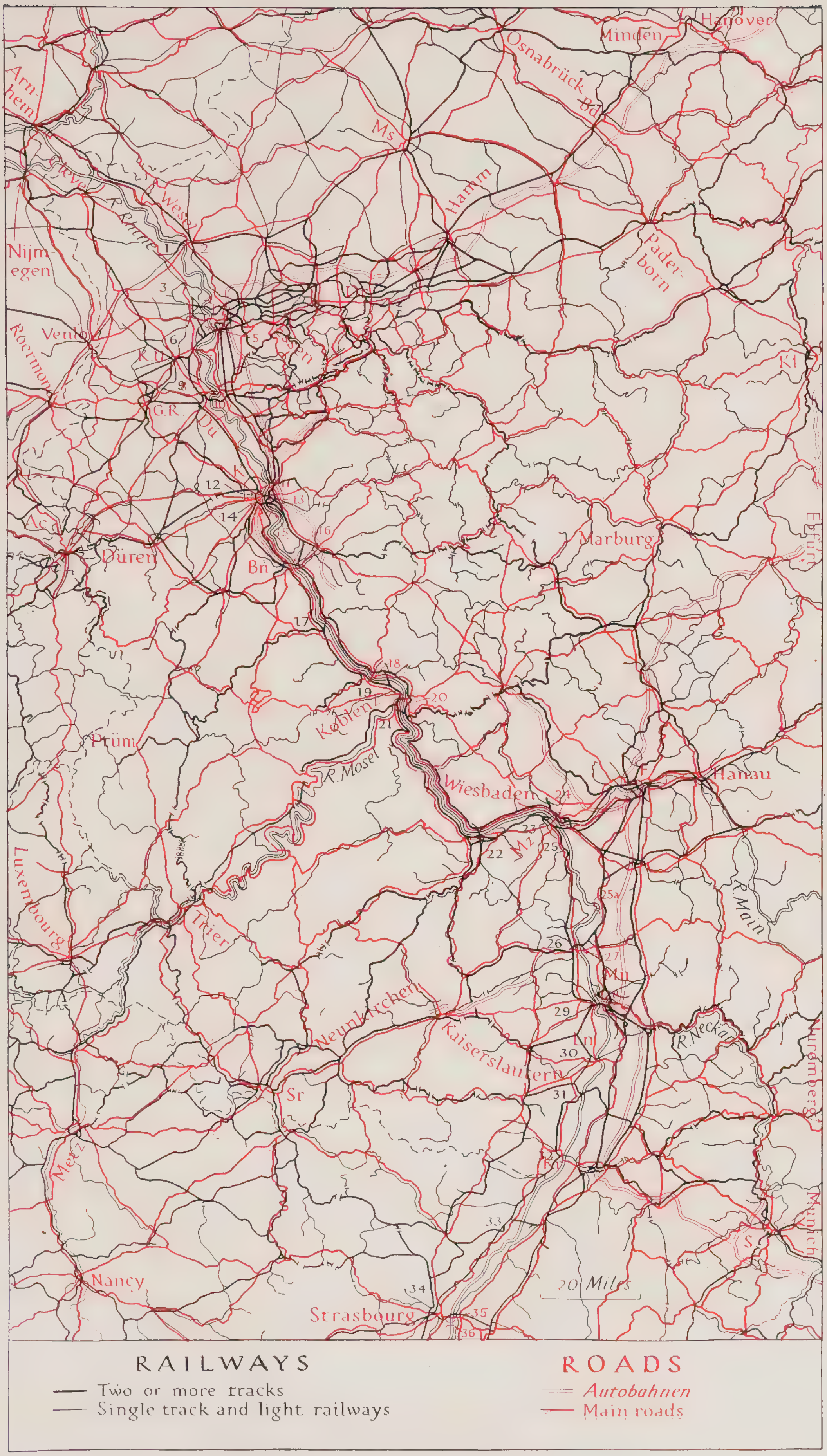

Fig. 117. The lower and middle Rhine: roads, railways and bridges

For key see Fig. 118 (on next page).

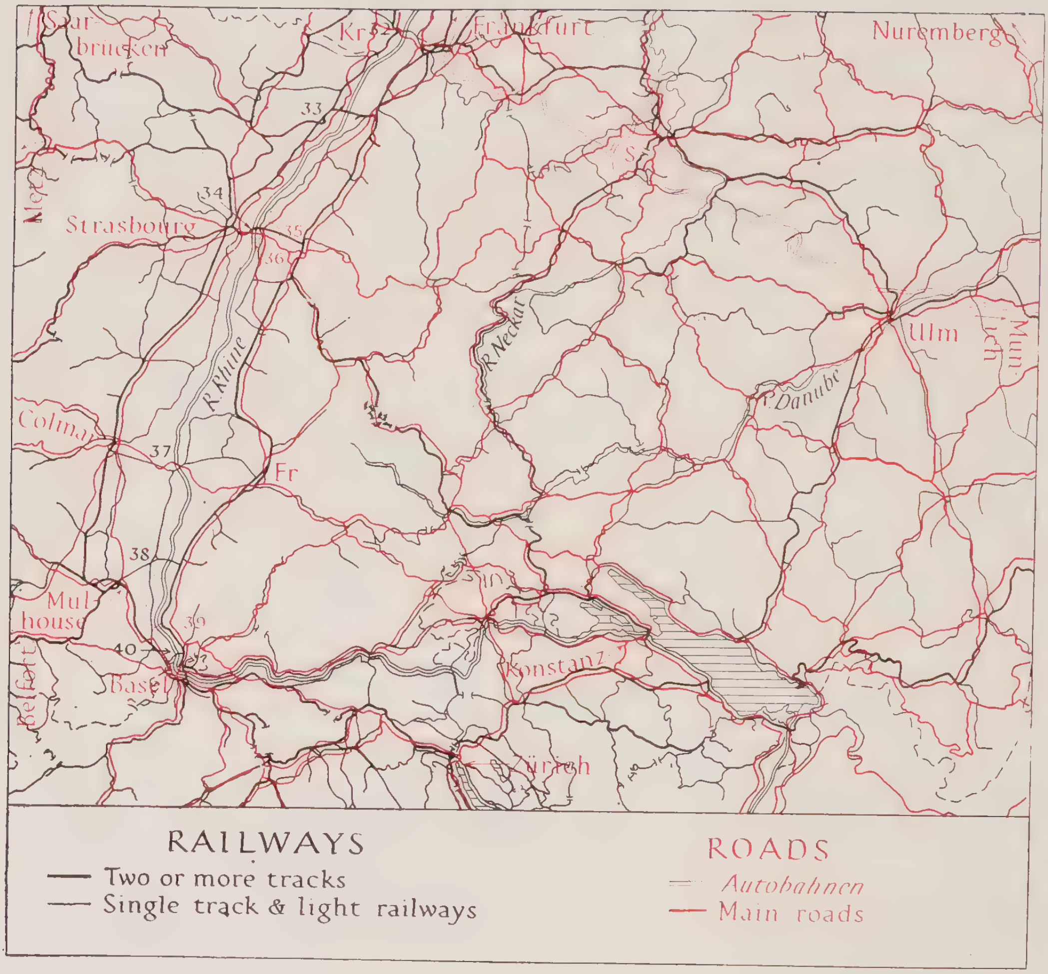

Fig. 118. The upper Rhine: roads, railways and bridges

These two maps are based on G.S.G.S. Series 4072, Europe (Air), 1 : 500,000 (1940–2), Sheets N.E. 46/6, N.E. 48/6, N.E. 50/6.

A Aachen; Bn Bonn; Dr Dortmund; Du Düsseldorf; F Frankfurt-am-Main; Fr Freiburg; GR Gladbach-Rheydt; K Köln; Kl Kassel; Kr Karlsruhe; KU Krefeld-Uerdingen; Ln Ludwigshafen; Mn Mannheim; Ms Münster; Mz Mainz; S Stuttgart; Sr Saarbrücken. The road bridges are numbered according to the numbering in the table on pp. 499–502. The rail bridges (details of which are given on pp. 300, 314, 328, 341) are as follows: 1 Wesel; 3 Homberg; 6 Rheinhausen; 9 Düsseldorf; 12 Hohenzollern; 14 Deutz; 17 Remagen; 19 Neuwied; 21 Koblenz, Niederlahnstein; 22 Rüdesheim; 23, 25 Mainz; 26 Worms; 29 Ludwigshafen; 30 Speyer; 31 Germersheim; 32 Maxau; 33 Wintersdorf; 34 Kehl; 37 Breisach; 38 Neuenburg; 40 Weil. Some sections of autobahnen have since been completed.

Chapter V

WATERWAYS

General Features: Introduction; Historical Background; Waterway Administration; Technical Features; Waterway Craft; Waterway Traffic.

Geographical Description: Waterways of Western Germany; Waterways of South Germany; Waterways of North-West Germany; Waterways of North-East Germany; War-time Conditions, 1939–44.

Bibliographical Note.

GENERAL FEATURES

Introduction

Germany has taken a leading place in the development of inland waterways. The last thirty years, especially, have seen the elaboration of plans and the execution of works which have provided the country with a number of large canals linking the great rivers to form a comprehensive network. The Prussian Waterway Law of 1905 was a principal milestone in this development. Both before and after that date political as well as economic motives have played a vital part in waterway policy.

The physical geography of Germany has facilitated this development of inland navigation. Among European rivers the Rhine is unequalled in the facilities which it offers, and, in the North German Plain, the Elbe and the Oder follow courses which favour the movement of cargoes towards the chief centres of industry and population. Limitations arising from the nature of their regime and volume of water have been capable of reduction by engineering works, even if they are not yet entirely eliminated. Politically, the Rhine suffers from the drawback (from the view-point of German industrial and transport interests) that its mouth lies in the Netherlands, and an economic consequence is that considerable profits in an enormous carrying trade pass to Dutch, and to a lesser extent, to Belgian interests. Nevertheless, the river provides the heavy industries of the Ruhr with the great advantage of very low costs for the transport of ore and coal. Other important centres of population which benefit from proximity to great navigable waterways are Berlin, Hamburg, Stettin, the cities of south-west Germany, and the Upper Silesian coalfield. Of the eleven cities which had a population of 500,000

or more in 1939, eight owe their importance in a considerable degree to their position on inland waterways.

The total length of canals and rivers which can be used for inland navigation is approximately 8,000 miles. Of this total, about 4,600

Fig. 119. The principal inland waterways

Based on official sources.

B Berlin; D.E.C. Dortmund-Ems C.; D-R Duisburg-Ruhrort. In addition to the waterways shown there are many small rivers and canals of restricted value for navigation. Arrows show connexions with waterways in neighbouring countries. The main German waterways take up a fairly simple pattern, with the Rhine, Dortmund-Ems C., Weser, Elbe and Oder connected transversely by the Rhine-Herne C., Mittelland C., and Mark waterways. Note: the Weser from Bremen to Minden (at the junction with the Mittelland C.) is shown as admitting 1,000-ton barges: the latest reports show that the canalization of the Weser is not yet complete and that a 650-ton barge is the largest which can use the river.

miles are of major importance; this length includes 1,500 miles of canals. Most of these principal waterways admit barges with a carrying capacity of 1,000 tons. The whole network carried 133,000,000 tons of cargo in 1937, a quantity substantially greater than the internal cargo on the Netherlands, Belgian and French waterways

combined. This tonnage represented the greatest ever carried on the network (up to that date: see p. 618).

In spite of the interest shown by the state, however, and in spite of the considerable amount of expert planning and investigation which has been made available, the waterways of Germany do not yet present an ordered picture. The more far-sighted engineers and economists, as well as generals, had long urged the development of canals and rivers to form a system, but, by 1939, even with the measures effected by the National Socialist government, the network had not properly become a system. There is no simple classification of waterways by craft capacity as in France and Belgium. The rivers vary greatly in their capacity, and the canals evidence a long-standing piecemeal development, many having been constructed without consideration for nation-wide interests. There is no simple classification of vessels—over 32 principal types (over 140 tons deadweight capacity) are in use. There is no general system of freight charges over all the waterways, and over certain stretches charges were artificially raised in order to placate interests opposed to waterway development. The opening in 1938 of the Rothensee ship-lift, on the Mittelland C., by providing a link for large barges between the Rhine, the Ruhr, Berlin and the Oder, marks an important stage in the history of the German waterway network, for it brought all the main waterways into direct connexion with each other for the first time, and re-emphasized the competition between the various interests affected by the development of inland navigation.

Historical Background

From the earliest times Germany's inland waterways have played an important part in the movement of goods and passengers. The considerable volume of many of the rivers favoured the growth of water-borne traffic. The largest and most convenient river for navigation flows through the part of the country which was, for centuries, the economic centre of gravity. A characteristic feature of the development of the network of waterways has been the dominant rôle played by 'free' (or unregulated) rivers—particularly the Rhine—in comparison with regulated rivers and canals. The dominance of the free rivers has been reduced in the present century, for important canals have been constructed, while the demands of trade have led to the development of extensive schemes for river regulation. When the improvement works on the Elbe, Oder, Weser and Danube

have been completed, the Rhine will be the only free river, of any size, remaining (i.e. below the Kembs barrage).

The Period before 1500

In the days of the Romans the Rhine was navigable above Strasbourg; the Mosel was navigable between Metz and Koblenz; and the upper Danube was partially navigable. The Rhine was used for both commercial and military purposes: Köln traded directly with London by water, while Drusus stationed a fleet at Bonn. He had a canal built (the *Fossa Drusiania*) from the Rhine to Lake Flevus—now part of the Yssel Lake—and so was able to move a fleet from the Rhine to the North Sea. His ships went as far as the mouth of the Ems. Subsequently his brother Tiberius sent a fleet up the Elbe.

An early scheme for the improvement of Germany's waterways by the construction of a canal came in the reign of Charles the Great. Einhard writes in his *Annals* that the Emperor was 'convinced by some persons who claimed to be experts that if a navigable moat were constructed between the rivers Regnitz and Altmühl it would be possible to voyage in comfort from the Danube to the Rhine, since one of these rivers (i.e. the Altmühl) flows into the Danube and the other (i.e. the Regnitz) flows into the Main. So he went with all his followers to the place and ordered a large number of labourers to be procured. They worked throughout the autumn. Between the two rivers a canal was cut 2,000 paces long and 30 feet broad. In vain. No permanent works could be built owing to the persistent rains and because in any case the marshy soil had too much water in it. However much soil was removed by the labourers during the day the level of the earth was restored to its original height during the night'. It has been suggested that Charles the Great's immediate object was to improve his communications before continuing his campaign against the Avars. 'There was no question in the time of Charles the Great of creating an effective waterway between the North Sea and the Black Sea.'

In the middle ages the great rivers were used for the transport of goods and passengers. There were, however, many hindrances to traffic by water. Rocks, tree trunks and other natural obstacles impeded navigation, and poor towpaths hindered travel upstream. Since the rivers were unregulated periods of low water sometimes alternated with disastrous floods. In places the river channels were continually changing. An examination of a modern map of the Elbe shows many relics of medieval channels—a series of 'dead' arms of

the river between Aken and Wittenberge; the Dive-Elbe and the Gose-Elbe (in the Vierland district); the *Marschen* above Hamburg; the intricate channels between Hamburg and Harburg; the *Binnenelbe* near Wedel; and the Süder-Elbe in the Land Kehdingen district. The Rhine and the lower Oder eventually required extensive straightening in their courses.

River tolls—which, like road dues, were not infrequently of an extortionate nature—were levied by territorial magnates. On the Rhine their number rose from 19 at the end of the twelfth century to over 60 in the fourteenth century, and the picturesque castles on the banks of the river which the modern tourist admires were often medieval toll stations. At one point on the Mosel the Count of Luxemburg levied such high tolls at the beginning of the fourteenth century that the citizens of Trier destroyed the castle which housed his rapacious collectors. Towards the close of the middle ages there were some 35 tolls on the Elbe. At the same time the stretch of the Danube in Lower Austria was reported to have no less than 77 tolls, but this may have been an exaggeration. It was not without cause that Germans complained bitterly of the *injusta thelonea*.

Despite these difficulties, some rivers carried a good deal of traffic. By the fourteenth century there were on the Rhine regular services of vessels carrying passengers and light goods between Koblenz and Andernach, between Mainz and Oppenheim, and (daily) between Mainz and Frankfurt-am-Main. The customs house registers of Koblenz show that coal from the Ruhr was being moved regularly on the Rhine in the middle of the fifteenth century. On the other hand, the important stretch of the Elbe between Magdeburg and Hamburg carried little traffic in medieval times. And the Danube was seldom used for through water-borne traffic. The ship that is recorded as leaving Vienna in 1278 for the Black Sea was embarking upon an unusual voyage.

It was comparatively rare for river regulation or canal construction to be attempted in Germany in the middle ages. The construction by the Lübeck merchants of the Stecknitz C. (1390–8) as a link between the Baltic and the Elbe was an important venture for that time.

The Period 1500–1815

From the beginning of the sixteenth century to the end of the eighteenth century Germany's inland waterways were of substantial importance—partly owing to the unsatisfactory state of the roads—for the movement of both passengers and goods. But traffic was still

seriously hampered by natural obstacles and by numerous restrictions on the freedom of river shipping imposed by various authorities.

The mouth of the Oder was silted up in the seventeenth century. Further upstream the river was impassable at Frankfurt-an-der-Oder and so there was a sharp division between the navigation of the upper and lower reaches. On the Rhine, the rocks at Bingen were long a great danger to shipping. Blasting operations with gunpowder were attempted in the sixteenth century, but it was not until the end of the seventeenth century that large timber rafts could be safely navigated downstream from the Black Forest. As late as the second half of the eighteenth century navigation of both the upper and lower Rhine was restricted by the fact that the river frequently changed its course; in the Xanten district on the lower Rhine, for example, the river flowed in a dozen different channels in 1763.

Three main types of restrictions hampered the free navigation of German rivers. First, numerous tolls were levied, and the rates charged often far exceeded the cost of maintaining the banks and towpaths or of giving protection to shipping. At the end of the seventeenth century there were 25 tolls to be paid on the inland waterways —mainly to the Brandenburg authorities—between Krossen (on the Oder) and Hamburg. On the Elbe between Melnik and Hamburg tolls had to be paid at 48 different toll stations in 1661. Early in the eighteenth century it took over 4 weeks for a ship to go from Dresden to Hamburg: had there been no delays at toll stations the journey could have been done in about 8 days. On the Rhine from Strasbourg to the Dutch frontier there were 32 toll stations: the archbishops of Köln and the Dukes of Cleves were notorious for their rapacity in levying numerous and heavy dues on the stretches of the river that they controlled. On the Weser from Elsfleth to Minden there were 32 toll stations in 1710.

Secondly, certain towns secured the right of compelling merchants to use their harbours. Nearly all goods coming by water to such privileged towns had to be transferred from one ship to another. It was hoped that local shipping agents and shippers would profit from this arrangement. Not infrequently the goods had to remain in port for 3 days—the *drei Sonnenscheinen*—and had to be offered for sale. Such a regulation might be enforced even if the goods were on their way to someone who had already purchased them. On the Rhine the chief 'staple' ports—as they were called—were Köln, Mainz and Strasbourg, although Speier and some smaller places eventually also secured staple rights. On the Danube there were staple ports between

Ulm and Budapest. On the Elbe the ports of Hamburg, Magdeburg, Dresden and Pirna had staple privileges. Lüneburg, although it lay some distance to the south of the lower Elbe, was able (until 1538) to force merchants to unload their cargoes and bring them by wagon to the city.

Thirdly, the shipping gilds of certain towns—usually the staple ports—acquired the monopoly of serving a particular stretch of a river. Thus the shippers of Holland and Köln served the lower Rhine; those of Mainz, the middle Rhine; and those of Strasbourg, the upper Rhine. Sometimes the gilds of other ports were able to secure a share of the Rhine traffic.

It may be added that in the seventeenth and eighteenth centuries merchants could not normally choose a ship to transport their wares. Vessels left port in strict rotation and the shipper of goods had to take the first available vessel.

A great variety of goods was carried by water. After the coming of the railways the rivers and canals transported, as a rule, only a limited range of heavy bulky goods, but in earlier centuries most types of goods went by water. On the Rhine, for example, the slate and basalt from riverside quarries; the cloth of Basel, Strasbourg, Aachen and Köln; the metalware of Stolberg and the Siegerland; and the weapons of Köln were all to be found on river craft. The Ruhr carried coal from the County of Mark to Ruhrort, and the Oder carried linen from Silesia. Timber was not loaded on to river craft—the tree trunks were bound together into rafts and were floated and rowed downstream. For centuries, wood from the Black Forest reached Holland in this way. It was not uncommon for a large timber raft to require a crew of 900 oarsmen and other workers to bring it downstream.

Local river traffic both for passengers and light goods used different vessels from those employed on long-distance traffic. As its name suggests, the *Marktschiff* was originally a ship which ran to a local centre on market days. Later, services were introduced independently of market days and longer journeys were undertaken. In the sixteenth century, for example, Mainz and Köln were linked by a regular service of *Marktschiff*. It was an uncomfortable and slow means of transport. Even at the beginning of the nineteenth century a *Marktschiff* took 30 hours to go from Mainz to Köln—a journey which now takes only between 8 and 9 hours. Werner Sombart describes the *Marktschiff* as the first transport service to run on the 'principle of the omnibus'—that is to say, a vehicle which is

not chartered by a particular customer but runs regularly to pick up whatever passengers may present themselves.

The relative importance of river and road transport varied in different regions. In the Elbe and Weser districts it appears that river traffic was more important than road traffic in the seventeenth and eighteenth centuries. It was reported that in 1798 no less than 460 vessels were operating on the Elbe between Magdeburg and Hamburg. In the Rhine valley, on the other hand—or at any rate in parts of the valley—the traffic by road seems to have been greater than by water. In the middle years of the eighteenth century there were only just over 200 cargo vessels on the Rhine, and in 1783 twice as much freight—250,000 cwt. against 122,000 cwt.—reached Strasbourg by road as by water.

Various factors hampered the improvement and extension of the inland waterways between 1600 and 1800. Numerous wars, of which the Thirty Years War was the most destructive, seriously restricted all economic progress. The responsibility for the waterways now rested with the territorial princes and some of them ruled over small states with incomes inadequate for the financing of great public works. Moreover, petty rivalries prevented co-operation between states with territories on the same river.

The larger states, however, did something to improve their waterways. In Brandenburg-Prussia the Finow C., linking the Havel (near Liebenwalde) and the Oder (at Oderberg), was constructed in the seventeenth century and—after being destroyed in the Thirty Years War—was rebuilt by Frederick the Great. Another link between the waterways of Berlin and the Oder—the Friedrich Wilhelm Canal—was planned in the middle of the sixteenth century when the Emperor (who then ruled over the Lausitz) agreed to build the stretch between the Spree and Müllrose while the Elector of Brandenburg undertook to complete the canal to the Oder. But only the Emperor's share of the scheme was carried out at that time. The Great Elector completed the scheme by building the *Neuer Graben* which 'provided a new and cheap connexion between the upper Oder (Silesia, etc.) and Hamburg and avoided that great obstacle to trade, Frankfurt-an-der-Oder'. But its usefulness was impaired by the large number of tolls levied upon it and also by the fact that goods had to be transferred from one ship to another at Berlin.

The waterways of the Mark Brandenburg were also improved by the construction of the Plauer C. from the Elbe (below Magdeburg) to Plauen (near the city of Brandenburg) in 1743–5. It was $21\frac{1}{2}$ miles

Plate 99. Kehl, looking down the Rhine

This port handles timber from the Black Forest; a timber yard can be seen in the foreground. See also Fig. 132.

Plate 100. Mannheim: the city docks, looking north

On the left is the Rhine, with the *I.G. Farbenindustrie* plant on the Ludwigshafen bank; in the centre is the Mülhau Hafen, with the Central goods station on its east bank; farther to the right is the Binnen Hafen, and along the edge of the view the Verbindungs Kanal. In the background can be seen the Neckar, opening off to the Bonadieshafen (which leads into the Industriehafen and Altrhein, beyond the view).

Plate 101. The Rhine at Mainz

This view was taken from the road bridge, and shows the railway bridge upstream. The paddle tug with a train of barges in pairs is a typical Rhine tow.

Plate 102. Oberwesel: the Rhine gorge, looking downstream

Double track railways follow each bank. The white vessel is a passenger boat. The river anchorage is protected by a training wall, which restricts the strong currents of the gorge to mid-stream.

long and it provided a new route by which salt from Schönebeck could reach the Mark Brandenburg. From Plauen it was possible to reach the Finow C. by using the river Havel and a chain of lakes. In 1745 the Templin C. was built in the Ukermark to improve facilities for the export of grain and timber. In 1766 the Wehrbellin C. was constructed in the Ukermark. Another Prussian artificial waterway was the Bromberg C. (24 miles long) which—with the canalized lower Brahe—linked the river Netze (near Nakel) with the river Vistula (near Bromberg). This canal was built in 1773–4 in Frederick the Great's reign. In Silesia the Klodnitz C. (from Gleiwitz to the Oder) was built in 1788–1806. Between 1776 and 1778 nine locks were built on the stretch of the Ruhr which ran through Prussian territory, and a few years later further improvements to the river were completed by other states.

In 1777–85 a waterway was constructed between the lower Elbe and the Baltic—the Eider C., which ran through Holstein from Tönning (below Hamburg) to Rendsburg and Holtenau. Ships of 120 tons could use this canal, and in the forties of the nineteenth century it was reported that some 3,000 ships passed through every year. Its value would have been greater but for difficulties of navigation on the river Eider from the sea to Rendsburg and for the lack of a good harbour at Tönning. In a limited way, the Eider C. was a forerunner of the Kiel C. (see p. 108). Another eighteenth-century canal that deserves mention is the Max-Clement C. from Münster to Nordhorn near the Dutch frontier. The original intention was to continue the canal to the river Vecht, but this was not carried out.

The Period 1815–71

During the time of the Germanic Confederation (1815–66), the North German Confederation (1866–71) and the Zollverein (which began in 1834), the improvement of the network of roads and the building of railways was more striking than that of the internal waterways. Important waterway developments took place, however. The gradual removal of restrictions to free passage—numerous tolls, staple rights and shippers' monopolies—which had accumulated in past centuries was, on the whole, of greater significance than the regulation of rivers or the construction of canals. The work of the statesman in this period was more important than that of the engineer.

At the Congress of Vienna (1815) it was decided that navigation on rivers running through more than one state (or forming a frontier

between states) should be free to the citizens of all such states, from the sea to the upper limit of navigation. River dues were to be reduced as much as possible. In the next thirty years the freedom of navigation envisaged at Vienna was secured (by international agreements) on the Elbe (1821), the Weser (1823), the Rhine (1831) and the Ems (1843). Even so, there remained many vexatious dues on these rivers and there were other rivers on which small states abused their geographical position to levy unduly high tolls. When Nassau joined the Zollverein in 1836, for example, she successfully resisted demands that she should reduce the tolls she levied on the Rhine and Main.

Eventually further reductions of various tolls—shipping dues, *octroi*, transit dues, and so forth—were secured on the Rhine (1851 and 1866), the Weser (1856), the Elbe (1863 and 1870) and the Danube (Treaty of Paris, 1856). Between 1861 and 1863 shipping dues were reduced on the Neckar, Main, Lippe, Ruhr and Ludwigs (Main-Danube) Canal, and they were abolished on the Mosel.

The new measure of freedom of navigation on Germany's rivers led to an increase in traffic, especially in the thirties and forties when the network of railways was rudimentary. As early as 1816 a steamship had travelled up the Rhine from Rotterdam to Köln; by 1830 a dozen steamships were making regular voyages on that river. In 1843 Matthias Stinnes used an English-built steam tug on the Rhine to draw coal barges, and before long haulage by horses had ceased. In 1828 the river Oder saw its first steamer, and by the thirties steamers had appeared on the Danube. It was reported that between 1827 and 1832 three times as many goods reached Bremen by the Weser route as by road. The first steamships to operate on the inland waterways were of British construction, but in 1836 Friedrich Harkort built a river steamboat at Duisburg and himself took it down the Rhine into the North Sea and then up the Weser to Minden. In the following year he built another steamship in which he travelled from Duisburg direct to London. Although Harkort himself went bankrupt his pioneer work helped to establish in Germany a shipbuilding industry to serve the needs of the inland waterways.

At first the main work of river steamers was to carry passengers. It is interesting to observe that some of the early railways in Germany were constructed in order to feed this new river traffic. Such lines were those from Heidelberg to Mannheim (1840), from Elberfeld (Wuppertal) to Düsseldorf (1841), from Minden to Deutz opposite Köln (1847), and from Kaiserslautern to Ludwigshafen (1847). Sub-

sequently passengers went by rail and the rivers became more important for the transport of goods.

The following table shows how goods traffic on the Rhine increased in the middle years of the nineteenth century :

Goods Traffic on the River Rhine (*in thousands of tons*), 1836–60

Port	1836		1840		1850		1860	
	Up	Down	Up	Down	Up	Down	Up	Down
Emmerich (Dutch frontier)	87·8	241·5	128·0	253·8	173·7	399·5	300·5	745·0
Koblenz (Prussia)	81·4	72·9	163·2	128·3	322·4	262·9	614·7	449·0
Kaub (Hesse-Cassel)	76·3	69·0	160·8	113·9	336·8	230·7	600·9	335·2
Mainz (Hesse-Darmstadt)	70·4	54·0	135·5	79·9	274·6	175·6	497·3	294·5
Mannheim (Baden)	42·4	61·8	43·0	48·7	58·8	83·8	49·6	171·8

From: A. Sartorius von Waltershausen, *Deutsche Wirtschaftsgeschichte, 1815–1914*, p. 109 (2nd edition, Jena, 1923).

Where navigation was difficult, the railways in time took over the transport of goods as well. On the upper Rhine, for example, goods ceased to reach Basel by water after 1847 and Kehl (opposite Strasbourg) after 1855. For half a century Mannheim-Ludwigshafen was the head of the navigable river. The first modern docks at Mannheim were opened in 1840—the same year that the railway to Heidelberg was completed. On the opposite bank of the Rhine, Ludwigshafen's primitive harbour facilities were taken over by the Bavarian Government in 1843 and were greatly improved. After the middle of the century the rivers for the most part carried heavy bulk goods, while other traffic tended to use the railways. The Rhine, for example, carried coal, salt, iron ore and cereals, while the Elbe and the Havel carried timber, guano, iron, saltpetre, oil and soda. On the other hand, textiles, wine, fruit, tobacco and 'colonial goods' were generally moved by rail.

In addition to the reduction and removal of tolls on the principal German rivers something was done to improve the waterways of the country and to build new ones. These improvements were done to benefit individual Federal States. Before the establishment of a united Reich there was no national policy for the whole of Germany with regard to transport—whether by road, rail or inland waterways. The two most important schemes were undertaken in south Germany. They were the regulation of the upper Rhine and the construction of an artificial waterway between the Rhine and the Danube.

The first was a success; the second was a disappointment to its promoters.

The regulation of the upper Rhine was the work of a Baden official —J. G. Tulla—who had studied at the Paris *École Polytechnique* under Monge in Napoleon's day. The course of the river frequently changed and great damage was caused from time to time by floods. The scheme—originally approved by the *Magistrat du Rhin* at Strasbourg appointed by Napoleon—was eventually carried out after 1815 by agreement between states with territory on the upper Rhine. When Tulla's great project had been completed much farm land was saved from the danger of floods. It was this motive rather than a desire to improve navigation that was present in the minds of those responsible for the regulation of the upper Rhine. Navigation on this stretch of the river remained difficult, even after the regulation of the stream, and Mannheim-Ludwigshafen was the farthest point up the river normally reached by steamers and barges in the second half of the nineteenth century.

The other south German scheme was less successful. King Ludwig I of Bavaria conceived the grandiose project of linking the Rhine with the Danube through his territories. The idea of completing the *Fossa Carolingia*, begun by Charles the Great, fired his imagination. The Ludwigs C. took nine years to build (1836–45) and cost £1,500,000. From the Rhine to Bamberg traffic used the river Main; the canal, 112 miles long, was constructed from Bamberg to Dietfurt on the river Altmühl. From Dietfurt traffic went on the river Altmühl to Kelheim on the Danube (a few miles above Regensburg). The canal is a narrow and shallow waterway with 100 locks, and can carry only small craft up to 130 tons. Partly on this account and partly because of railway competition, the canal seldom carried enough traffic to make a profit. To-day it is used mainly for the local transport of timber and stones. Bavaria's waterways were also improved in the early nineteenth century by the regulation of the upper Danube (at Ingolstadt and Dillingen) and also of a stretch of the Isar.

In Prussia, too, some canals were built or improved between 1815 and 1870. Shortly after the new Province of Westphalia was incorporated into Prussia in 1815, its senior official (President), Ludwig von Vincke, succeeded in carrying out his plans to improve the communications of the Ruhr industrial area by regulating the river Lippe and extending the docks at Ruhrort. By 1830 the river had been made navigable as far as Neuhaus. After a period of usefulness, however, the Lippe ceased (about 1875) to carry much traffic owing to

railway competition. In the forties the *Landwehrkanal* was built in Berlin. In 1861–8 the Saar coal canal was built, the cost being shared by France and Prussia. This waterway linked the river Saar at Steinbach with the Rhine–Marne C. at Gondrexange and was 39 miles long. Coal traffic on the canal increased from 347,000 tons in 1867 to 546,000 tons in 1902.* The waterways of the Mark Brandenburg were extended by the construction of the Ihle C. from the Elbe to the Plauer C. (1866–71). In East Prussia the regulation of the river Minge and the building of the König Wilhelm Canal (27 miles) joined the river Memel (Almathstrom) to the Kurisches Haff at Schmelz near Memel (1863–73). In Silesia some works were undertaken on the Oder between 1848 and 1858.

The Period 1871–1905

Germany's interest in her inland waterways revived shortly after the founding of the united Reich in 1871: 'firstly, because water carriage offered great advantages for many purposes of transport and for many specially situated centres of industrial activity and of consumption; secondly, because the opinion gained more and more ground that the railways would be unable to cope with the great development of the traffic of the country, requiring the transport of goods in bulk; thirdly, because these goods could be transported more economically and cheaply by water; and lastly, because the construction of both systems of carriage would tend to create and assure more favourable conditions for the development of the country' (W. H. Lindley).

Even after 1871 the inland waterways of Germany did not come under unified control. The administration of existing rivers and canals and the improvement and extension of the system of waterways were still in the hands of individual Federal States.

Between 1871 and 1905 the following stretches of rivers were canalized, totalling 425 miles:

1. The Saar, from Ensdorf (near Saarlautern) to the Saar Coal C. (1862–6 and 1875–9).
2. The Main, from the Rhine to Frankfurt-am-Main (1883–6) and thence to Offenbach-am-Main (1900–1).
3. The Main and the Regnitz, from Bischberg to the Ludwigs C.
4. The Fulda, from Minden to Kassel (1893–7).

* References to the Saar waterway will be found in the N.I.D. Handbook on France, vol. IV, p. 414.

5. The Saale, from the Elbe to Halle.

6. The Saale and the Unstrut, from Halle to Bretleben (1882 and 1889–90).

7. The upper Oder from the mouth of the Neisse to Kosel—including the canalized Alte Oder to by-pass Breslau (1891–7). The course of the lower Oder had been improved in the eighties. Largely as a result of these works, the amount of coal moved on the Oder rose from 130,000 tons in 1884 to just over 1,000,000 tons in 1897. With the canalization of the upper Oder the port of Kosel with its three large docks (built in 1895, 1901 and 1907) became the most important inland harbour east of Berlin.

8. The lower Netze, from Drage to Nakel (Bromberg C., 1891–6).

9. The upper Netze, from the Bromberg C. to the Russian frontier (1879–82).

Several important canals were constructed or improved in the last years of the nineteenth century. The Ems-Jade C., built in 1880–7, joined the naval base of Wilhelmshaven with the commercial port of Emden. The 17½-mile long Königsberg Sea C. (completed in 1901) ran—for the most part between embankments—through the shallow waters along the northern shores of the Frisches Haff between Königsberg and its Baltic outport of Pillau. The Kaiser Fahrt—completed at the end of the nineteenth century—greatly improved the Swine channel and enabled ships of 12,000 tons to pass from Swinemünde on the Baltic to the Stettiner Haff and so to the port of Stettin.

A project for building a canal from Dortmund to Emden came before the Prussian Diet in 1882, but was rejected by the upper house (1883). Shortly afterwards (1886) the scheme was approved and the 167-mile-long Dortmund-Ems C. was built in 1892–9. Starting from the heart of the Ruhr industrial district, this great waterway was carried by large aqueducts over the rivers Lippe, Emscher and Ems. From Münster to Meppen the canal ran in the Ems valley on the east side of the river and parallel to it. From Meppen to Emden traffic used the canalized Ems. The 230-ft. fall between Dortmund and Emden was overcome by the Henrichenburg ship-lift and by 19 locks on the waterway below the ship-lift. The canal was built for 600-ton ships, but by 1905 vessels of over 800 tons were allowed to pass. The cost of the project—including new docks at Dortmund and at Emden—was just over £4,000,000.

When the scheme for a canal from the Ruhr to Emden was under consideration, some enthusiastic interests hoped that this waterway would enable the industrial districts of western Germany to become

—at any rate partially—independent of foreign ports such as Rotterdam and Antwerp. In fact the Dutch and Belgian ports—with harbour and shipping facilities far superior to those of Emden—continued to serve the Rhineland and Ruhr. Traffic on the Dortmund-Ems C., however, was substantial, and rose from 470,000 tons in 1900 to 4,000,000 tons in 1913 and 8,793,000 tons in 1928. The traffic of Dortmund harbour increased from 70,000 tons in 1899 to nearly 400,000 tons in 1906.

Farther east, developments included the construction of the Elbe-Trave C. (1896–1900) linking Lauenburg on the lower Elbe (34 miles above Hamburg) with the Baltic at Lübeck-Travemünde. Large Elbe barges of 1,000 tons and sea-going lighters could use the canal. Considerable improvements were made in the waterways of the Mark Brandenburg.

(1) The lower Havel was canalized from the Elbe to the Spree at Spandau (near Berlin) in 1875–82.

(2) The Havel-Oder C.—Spandau to Hohensaathen by way of the old Finow C.—was much improved in 1874–85.

(3) The Oder-Spree C. was reconstructed in 1887–97. It ran from the Havel at Spandau through Berlin to Köpenick and to the Oder at Fürstenberg, and provided an alternative route to the Finow C. from the Havel to the Oder. Traffic on the Oder-Spree C. increased from 637,000 tons in 1891 to 2,256,000 in 1905. Hamburg derived some benefits at Stettin's expense from the construction of this canal. Certain exports from Silesia—such as sugar, grain and zinc—now left Germany by way of the Mark Brandenburg waterways, the Elbe and Hamburg instead of using the old route to Stettin. Similarly imports to Silesia (e.g. petroleum) tended to arrive by way of Hamburg and the waterways between the Elbe and the Oder.

(4) The Teltow C. (Potsdam-Köpenick), built in 1901–6, carried boats of 600 tons, and enabled waterborne traffic on the Elbe-Oder route to by-pass Berlin. The cost of the Teltow C.—defrayed by the local authority (*Kreis*) of Teltow—was high (£2,350,000), partly because it was necessary to build 55 railway and road bridges over the waterway. Various industrial works, such as the Berlin gasworks at Mariendorf, quickly sprang up along the new canal.

In south Germany a short canal was built in 1888–91 to link Karlsruhe with the Rhine. Waterborne traffic at the Karlsruhe docks (Mühlburg) rose from 545,000 tons in 1903 to 2,332,694 tons in 1929. In Bavaria the regulation of the Main was the chief project undertaken before 1914. Preliminary improvements as far as Würz-

burg were completed in 1903. River traffic at this town rose from just under 5,000 tons in 1900 to 228,459 tons in 1913.

River canalization and the construction of new canals was accompanied by the improvement of several inland harbours. New docks were built at Mainz in 1887. Dortmund harbour was built to handle the traffic of the new Dortmund-Ems C., and extensions were made after 1899. At Frankfurt-am-Main the City Harbour was built in 1883–7 at a cost of £325,000, while a much more ambitious project was completed in 1906–12 when the East Docks were built (£3,600,000). At Ludwigshafen the Luitpold Harbour was opened in 1897. At Dresden the large Albert Harbour was constructed on the right bank of the Elbe in 1891–3.

W. H. Lindley reported in 1909 that the usefulness of the German waterways 'has been greatly increased and the cost of transport by water diminished by shortening as much as possible the time necessary for loading and unloading the boats. Some of the new harbours, for instance at Duisburg, Kosel and others, have been equipped with very complete arrangements for this purpose, consisting of coal chutes and tips, hydraulic steam and electric cranes, depots served by elevated lines of rail, fixed and movable grain elevators, granaries and sheds and all arrangements for handling bulk goods in the most rapid and cheap manner possible'.

Between 1875 and 1910 the share of Germany's total goods traffic carried by the inland waterways rose from 21% to 25%. The traffic on the inland waterways increased by substantially more than six-fold in the same period.

Development of certain German Inland Harbours, 1875–1905 (*Total Goods Traffic in thousands of tons*)

	1875	1895	1900	1905
Duisburg, Ruhrort, Hamborn	2,935	7,416	14,352	19,462
Berlin	3,239	5,134	6,637	10,114
Mannheim-Ludwigshafen	865	4,049	7,107	7,117
Magdeburg	676	1,512	1,995	2,008
Frankfurt-am-Main	201	751	1,305	1,580

From: W. H. Lindley, Report on the Waterways of France, Belgium, Germany and Holland (vol. VI, *Foreign Inquiry of the Report of the Royal Commission on Canals and Waterways*, Cmd. 4841 of 1909), pp. 204–5.

The waterway traffic was carried by a steadily growing fleet of barges and tugs. In 1912 cargo-carrying vessels numbered nearly 30,000, and disposed of an aggregate capacity of 7,394,000 tons. Owing to the increase in the size of vessels the carrying capacity of

the fleet expanded over three times in 1887–1912, whereas the number of vessels increased by only 50%.

Growth of the German Fleet of Cargo Vessels operating on Inland Waterways, 1887–1912

	Number	Capacity (tons)
1887	20,390	2,100,705
1897	22,564	3,370,447
1902	24,839	4,877,509
1907	25,235	5,914,020
1912	29,533	7,394,657

From: Werner Sombart, *Der moderne Kapitalismus*, vol. III, *Das Wirtschaftsleben im Zeitalter des Hochkapitalismus*, part i, p. 285 (München and Leipzig, 1928).

The Period 1905–19

On 1 April 1905 the Prussian Diet passed a law sanctioning the expenditure of nearly £17,000,000 on the construction and improvement of inland waterways in Prussia. This law was not passed without serious opposition. Various 'interests' which thought that they might be injured by some proposed new waterway were not slow to raise objections.

The possibility of linking the Ruhr industrial district with the Elbe had already been discussed in the early sixties and in the early eighties. On no less than four occasions—in 1883, 1893, 1899 and 1901—the scheme had been rejected by the Prussian Diet. Strong opposition had come from many quarters. The Silesian coalowners feared that such a canal would enable Ruhr coal to be sold more cheaply than their own products in eastern Germany. Industrialists interested in the production of lignite in Hanover and in the Prussian province of Saxony also opposed the building of the canal. So did some of the merchants of Hamburg, who imagined that the new waterway would bring greater benefits to their Bremen rivals than to themselves. Above all, the East Prussian junkers feared that the existence of cheap rates on the rivers and canals and the construction of new waterways like the proposed Mittelland C. would enable foreign grain to compete successfully with their own products.

Eventually, in 1905, the Prussian Government decided to build only the western half of the Mittelland C.—the Ems-Weser section as far as Hanover—and to defer to a later date the eastern extension to the Elbe. The Silesian coal magnates were placated by a vote of £1,000,000 for the further regulation and improvement of the upper Oder and the extension of the harbour facilities at Kosel. The objections of the critics were also met in another way. The transport

of goods by water was made more expensive by the re-imposition of shipping dues. It will be recalled that these tolls had—after very long negotiations—been abolished in the nineteenth century. Section XIX of the Prussian Law of 1905, however, provided that 'tolls shall be levied on rivers regulated in the interest of navigation. The tolls shall be of such amount that the proceeds shall cover a reasonable interest and repayment of capital spent by the State on the improvement or deepening of these rivers beyond the natural limit in the interest of navigation. The raising of these tolls shall begin at the latest with the coming into use of the whole or part of the Rhine-Weser Canal'. The last sentence shows clearly that the revival of shipping tolls on the inland waterways was part of a bargain to overcome opposition to the construction of the first part of the Mittelland C. This law applied only to Prussia, but a German Shipping Dues Act was passed in 1911.

As finally passed, the Prussian Law of 1905 provided for the building of the Ems-Weser and Rhine-Herne Canals; the improvement of the so-called Berlin—Stettin Ship C. and the waterways linking the Oder and Vistula; as well as the canalization or regulation of stretches of the Oder and Lippe. A Prussian Law of 1908 extended this programme by authorizing the construction of a Masurian Ship C. to link the Masurian Lakes with Königsberg at a cost of £781,000.

By 1918 important parts of the ambitious programme of 1905 had been completed. In 1914 the Rhine-Herne C. was opened and so direct communication by water was established entirely through German territory between the Rhine and the North Sea. Running from Herne (near Bochum) to Ruhrort, this canal was carried over the roads and railways of a highly industrialized region by 39 aqueducts. Traffic rose from 592,000 tons in 1914 to 7,239,000 tons in 1922. In 1914 also the Berlin—Stettin Ship C. (121 miles long) was completed at a cost of £2,000,000. This consisted of four waterways: (i) the Berlin—Spandau C. (ii) the river Havel, (iii) the Hohenzollern C., and (iv) the lower river Oder. It accommodated barges of 600 tons. The completion of the Berlin—Stettin C. did not, however, lead to an increase in the 'inland' traffic of Stettin; in fact, this traffic dropped from 4,240,000 tons in 1913 to 2,670,000 tons in 1928. (This canal is often referred to as the Berlin—Stettin Ship C., but is not a ship canal in the usual sense of the term.)

In 1915 the Ems-Weser C. was completed from Bergeshövede (on the Dortmund-Ems C.) to the Weser (at Minden), and shortly afterwards it reached Hanover. This waterway was the first portion of the

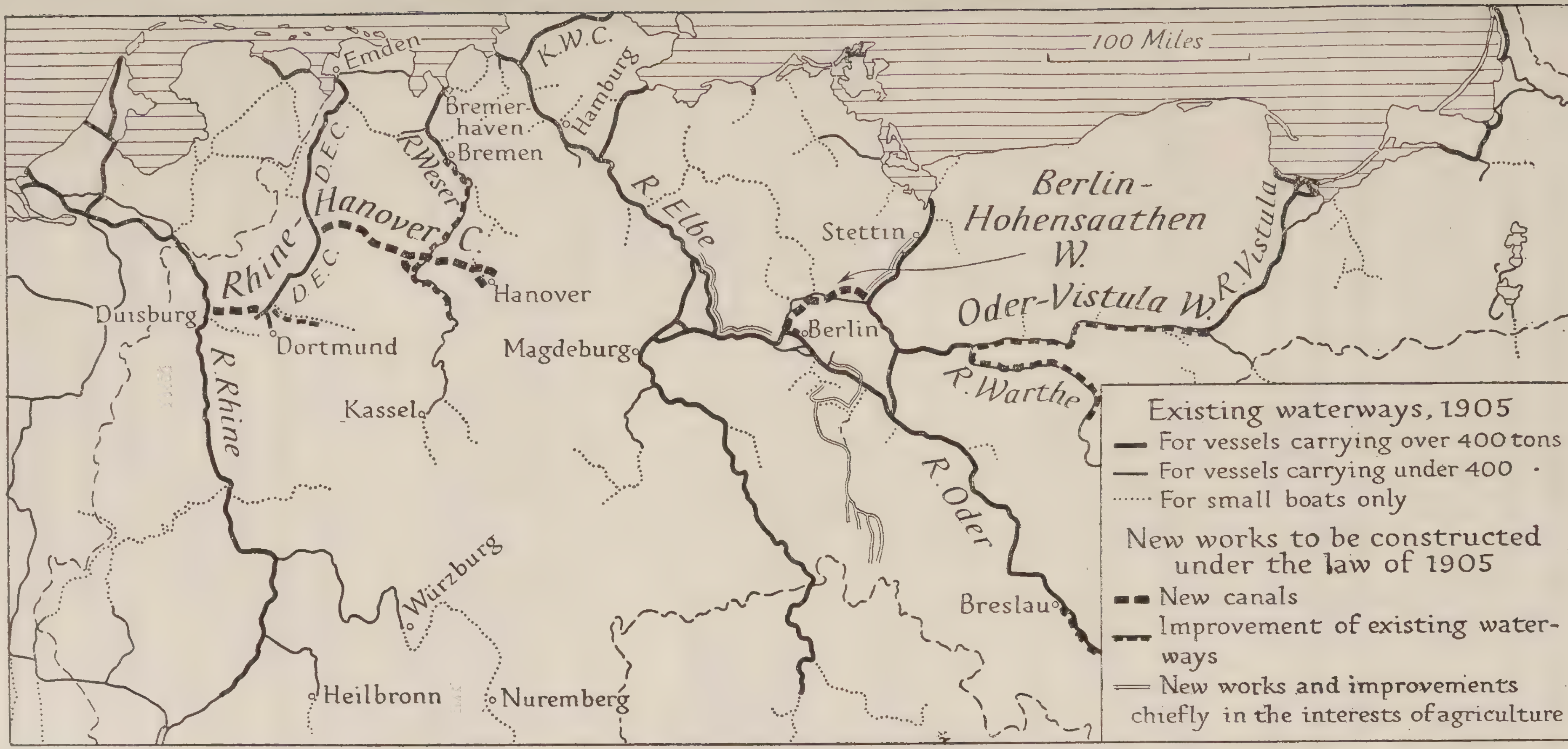

Fig. 120. Principal inland waterways in north and central Germany, 1905

Based on Lindley, W. H., 'Report on the Waterways of France, Belgium, Germany and Holland', Map G.I. (vol. VI, *Foreign Inquiry, Royal Commission on Canals and Waterways*, Cd. 4841 of 1909, H.M.S.O., London).

D.E.C. Dortmund-Ems C.; K.W.C. Kaiser Wilhelm (Kiel) C.; W. Wasserstrasse. This map shows (*a*) the main German inland waterways existing before the passing of the Prussian law of 1905 for the extension of the Prussian network of canals and navigable rivers, (*b*) the new waterways approved by that law. The 'Rhine—Hanover C.' is now represented by the Rhine-Herne C., Dortmund-Ems C., and western portion of the Mittelland C. The 'Berlin—Hohensaathen Wasserstrasse' (Hohenzollern C.) is a link in the system of waterways sometimes known as the 'Berlin—Stettin Ship Canal'.

proposed Mittelland C. from the Rhine to the Elbe. It is interesting to observe that in 1917 von Breitenbach (the Prussian Minister of Transport) declared that 'the experience of the war' had made it clear that it was essential to complete the Mittelland C. to Magdeburg.

In 1917 two parallel canals—the *Breitenbachfahrt* and the *Flutkanal*—were built between Wilhelmshaven and the Gröschel Brücke to provide an improved by-pass round Breslau for traffic using the Oder (Fig. 146).

Coal and Coke Traffic along the Rhine-Herne Canal to Ruhrort in 1915

To Ruhrort from Harbours of	Coal and Coke (tons)
Arenberg-Prosper	261,911
Bergfiskus	486,552
Bismarck	277,370
Concordia	122,549
Dortmund	29,104
Emscher-Lippe	3,600
Friedrich der Grosse	154,153
Hardenberg	1,348
Hibernia	17,161
Köln-Neuessen	48,301
König Ludwig	104,320
König Wilhelm	24,952
Mathias Stinnes	248,990
Minister Achenbach	30,990
Nordstern	42,738
Victor	18,859
Wanne-West	303,378
	2,176,209

From: *Glückauf*, 15 January 1916, p. 60.

The great bulk of the dispatches by waterway from Ruhrort originate as transhipped cargoes brought to the port by rail. Many of the harbours named are shipping points for coal mines.

The Period 1919–39

Between 1919 and 1939 Germany's inland waterways were further improved. The eastern portion of the Mittelland C. (Hanover to Magdeburg) reached Peine in 1928 and was completed at the end of October 1938. Over 30 million tons of goods traffic used the canal in 1937, i.e., from and to western destinations: Elbe traffic could not pass until the completion of the Rothensee ship-lift in 1938 (see p. 595). A short branch line joined the principal canal to the iron and steel works of the *Hermann Göring* concern near Salzgitter. Progress was made with the construction of the great Rhine-Main-

Danube waterway on a scale of which King Ludwig could not have dreamed a century earlier. The scheme for replacing the unsatisfactory Ludwigs C. provided for the regulation of the Main to Bamberg and then for the construction of a canal to Kelheim on the Danube. The Main had already been improved as far as Frankfurt a.M. in 1886 and Offenbach a.M. in 1900. By 1920 the section between Offenbach and Aschaffenburg had been regulated. In 1922 a new scheme was launched to link the Main and the Danube by a system of waterways capable of taking vessels of 1,200 tons. By 1931 the Main had been improved to Kleinheubach. In 1937 the river was navigable for ships up to 1,200 tons as far as Würzburg and the stretch of the Danube between Passau and Regensburg had also been regulated. Since 1939 some improvements to the Würzburg-Bamberg stretch of the river Main were started with the labour of prisoners of war.

Several other schemes were undertaken, such as the Küsten C. (which left the Ems 60 miles north of the junction of the Dortmund-Ems and Mittelland canals and joined the Weser 20 miles north of Bremen); the Elbe-Havel C.; the canalization of the Neckar between Mannheim and Heilbronn (72 miles); the rebedding of the lower Main; the canalization of the Saale to take 1,000-ton vessels; and the regulation of the upper Rhine from Kehl (opposite Strasbourg) to Istein (near Basel), where a canal avoids the rapids.*

Waterway Projects

Several important projects for the improvement of Germany's system of inland waterways have been envisaged. Hamburg and Bremen favour the construction of a waterway to provide a more direct route to the Ruhr than that afforded by the Mittelland C., with its detour by way of Magdeburg. This proposed Hansa C. would run from the western end of the Mittelland C. (north of Osnabrück) to Bremen and Hamburg. A project for another link between the North Sea and the Mittelland C. is that of a North-South C. running south from Hamburg and reaching the Mittelland C. at Hanover or Brunswick. During the war of 1914–1918 a scheme was discussed for building a canal in Austria between the upper Elbe (at Pardubitz) and the river March—a tributary of the Danube—at Prerau. Such a waterway would benefit Hamburg. The territory in which the proposed canal would run now lies in Czecho-Slovakia.

* For the Upper Rhine since 1919, see also the N.I.D. Handbook on France, vol. IV, pp. 404–10.

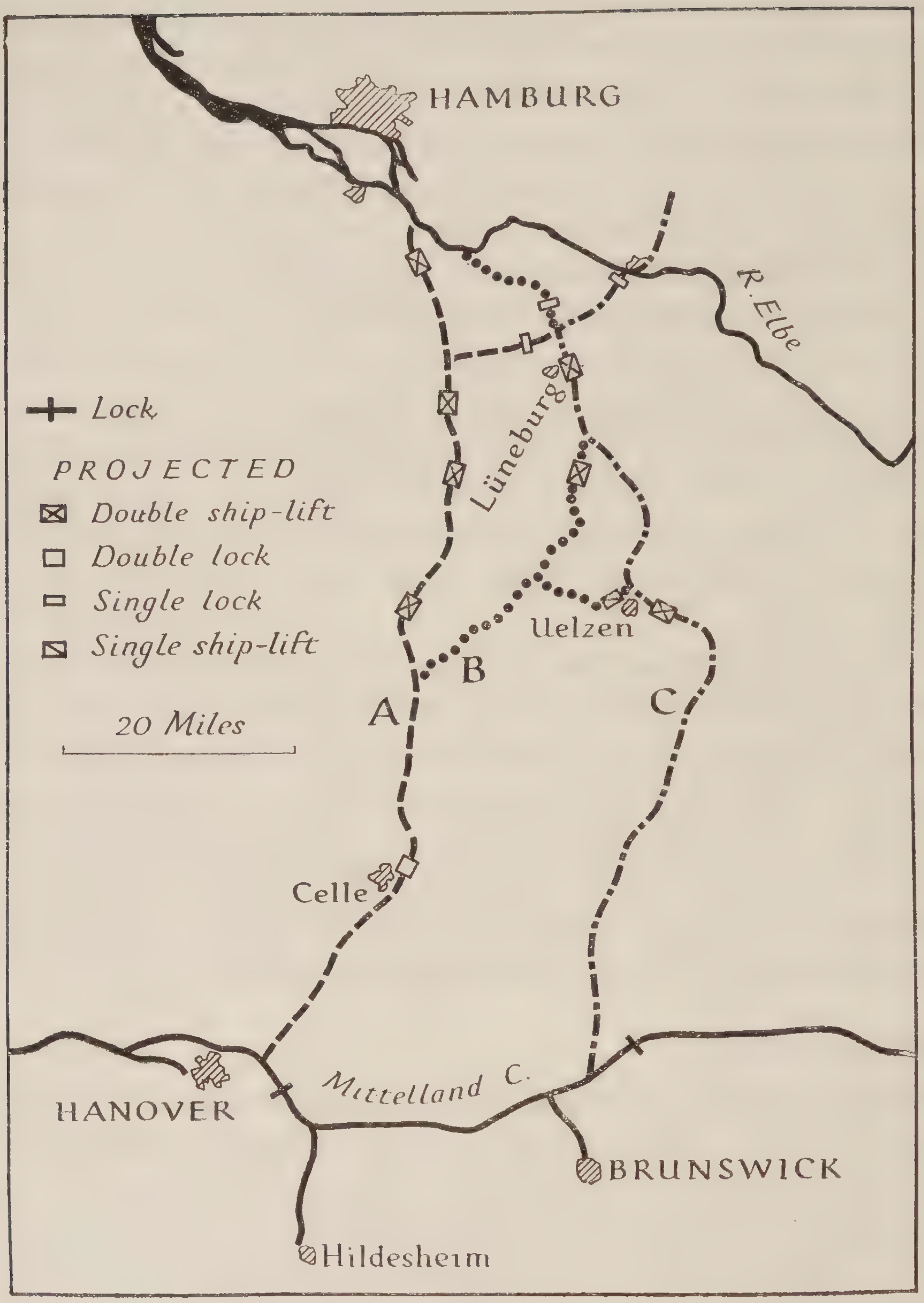

Fig. 121. The projected North-South canal

Based on Franzius, L., *Waterway Engineering*, trans. Straub, L. G., p. 489 (Cambridge, Mass., 1936).

Various engineers have put forward plans for a direct canal between Hamburg and the Hanover district. The specific routes favoured by three different engineers are shown by 'A', 'B' and 'C'. The crossing of the relatively high ground of the Lüneburg Heath would necessitate the construction of several locks and ship-lifts.

Work had been started on a scheme to link the Rhine and the Danube by an alternative route to the Main-Danube C. now under construction, using the Neckar instead of the Main. The Neckar, already regulated to Heilbronn, would be made navigable to Plochingen.

From there waterways would be constructed to the upper Danube (at Ulm) and to Lake Constance (at Friedrichshafen). Another proposal is for a new central canal—roughly parallel to the Mittelland C.

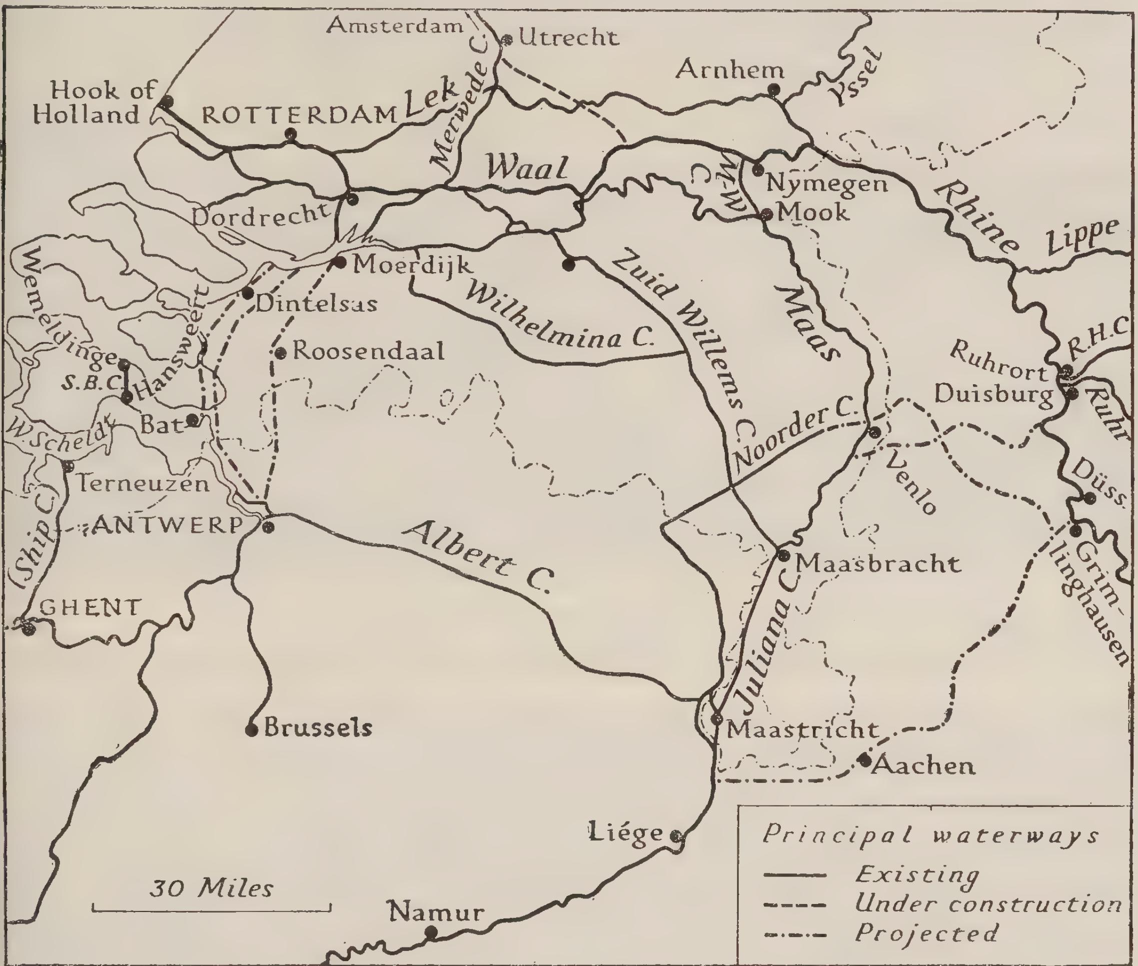

Fig. 122. Projected canals between the Rhine and Antwerp

Based on Schuiling, R., *Nederland*, vol. II, p. 420 (Zwolle, 1936); Delmer, A., *Le Canal Albert*, vol. II (Liége, 1939).

Düss. Düsseldorf; R.H.C. Rhine-Herne C.; M.W.C. Maas-Waal C.; S.B.C. South Beveland C. These projects—the Moerdijk canals in the west, the Venlo-Rhine and Aachen-Rhine canals in the east—all represent frequently discussed plans for an improved connexion between Antwerp and the Rhine, and have been raised most often by the port interests of Antwerp. The Moerdijk projects (see the N.I.D. Handbook on the Netherlands, pp. 598–600) concern only relations between Belgium and the Netherlands, but the eastern projects concern Germany as well as Belgium. The Aachen route is the only one which does not pass through Dutch territory, and offers the greatest difficulty in construction. If the canal were built only to connect Aachen with the Rhine it would, of course, interest only Germany: its continuation to the Meuse would be of great value to Antwerp.

—which would run from Frankfurt-am-Main to Hallè and finally to Breslau (Silesia) and so form another link between the Rhine, Elbe and Oder systems of waterways.

Other proposals which have been made include a Saar—Palatinate

—Rhine C. from the Saar to the Rhine by way of Kaiserslautern, and for an Aachen—Rhine Canal. The latter has been also discussed in connexion with Belgian proposals to develop a direct canal route between Antwerp and the Rhine (Fig. 122 ; see also the N.I.D. Handbook on the Netherlands, chapter xix). It should be remembered that extensive discussion of projected waterways is common in Germany among engineers and economists, and that commercial interests in various localities often advocate plans. Of all these projects, the Hansa C. seems most likely to be achieved (see p. 594).

Waterway Administration

The state took control of inland waterways in 1921, and a policy of continued development was followed, subject to interruptions arising from political and economic causes. Many new works and extensions of existing works represented a continuation of plans dating back, in some instances, two or three decades, and there was hardly any development in progress in 1939 which was new.

By that year the waterway transport system was in a much better position to meet the needs of war than it had been in 1914. Not only had important improvements been carried out, such as the virtual completion of the Mittelland C., but transport interests had been thoroughly re-organized. In 1935 the Reichs Transport Group for Inland Shipping (*Reichsverband Binnenschiffahrt—R.V.B.*) was formed to take over the duties of the former National Committee for Inland Shipping. This body is the only one representing the independent proprietors and enterprises concerned with inland navigation. It advises the government on the one hand and organizes the trade on the other. By a decree of 1936 all shipowners, associations and freight committees were absorbed into the *R.V.B.*

Group Organization

The administration of installations is organized by the Trade Group for Ports and Loading and Discharging Plants, which is subdivided into four main sections. Private docks and transhipment plants come within the scope of this organization as well as publicly owned installations. The trade group for the inland shipping trade covers all the operators of waterways—tugboatmen, owners and charterers of lighters, pilots, skippers, freight contractors, charterers, etc. This group is subdivided into seven groups according to function.

Plate 103. Rhine quays at Düsseldorf, looking downstream

This view, taken from the right bank, shows the Oberkassel (*Skagerrak*) road bridge.

Plate 104. Düsseldorf: Customs and Commercial Dock

The docks of Düsseldorf lie to the west of the city in the neck of flat ground within a meander of the Rhine. The *Borussia*, 948 tons gross, sailed in the *Rhein—London Linie*, i.e. the 'Rhine—Sea' trade.

Plate 105. The Rhine between Homberg and Ruhrort
In the foreground is a Dutch Rhine paddle tug.

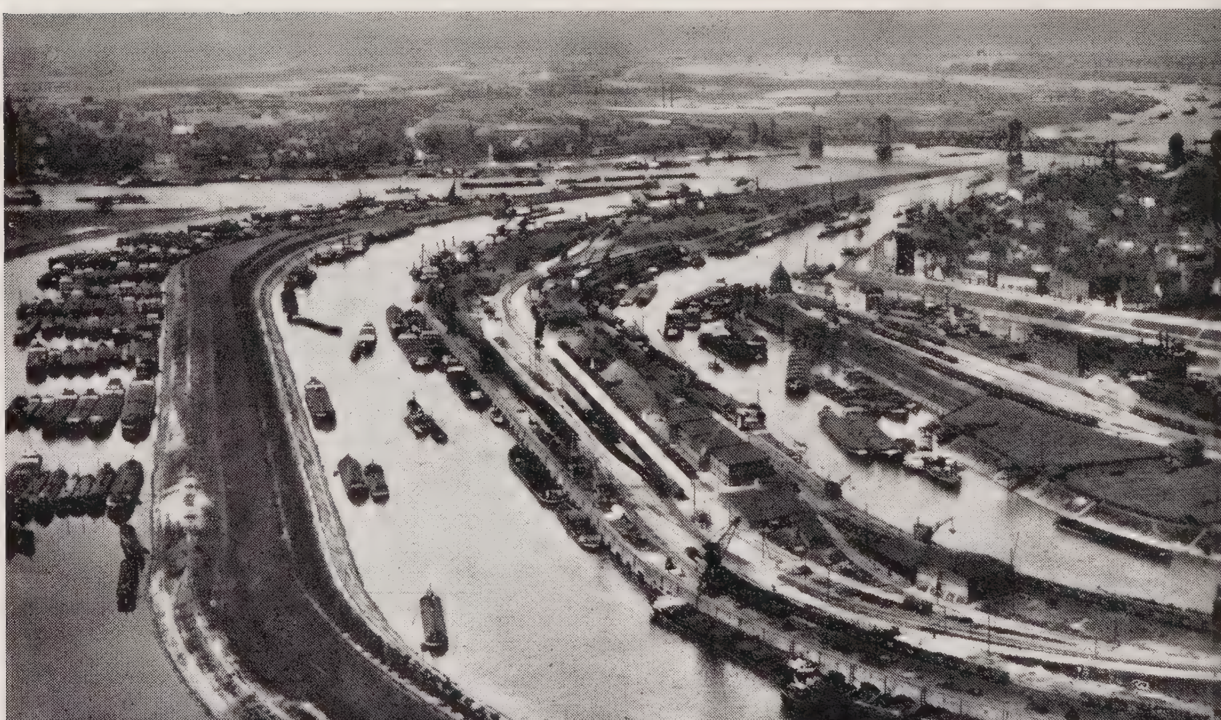

Plate 106. Duisburg-Ruhrort, looking north-west
On the left is the river Ruhr; the two basins in the centre and to the right are used for loading and unloading, although the main cargo shipment points are the *becken* farther east (Fig. 130). In the background is the *Admiral Scheer* road bridge over the Rhine.

Administration of R.V.B.

The *R.V.B.* is headed by an administrative council, the chairman of which is appointed by the Reichminister of Transport, who is the head of the *R.V.B.* The organization has a Business Administration Committee, which operates through district committees under district officers. Main offices exist at Duisburg, Dortmund, Hamburg, Berlin and Breslau. District offices are situated at these centres and at Königsberg and Regensburg. All trade groups coming within the purview of the waterway administration are organized according to districts analogous to those of the district offices of the *R.V.B.* :

(1) Rhine Region
(2) West German Canals and Weser
(3) Elbe Region
(4) Waterways between the Elbe and the Oder
(5) Oder Region
(6) East German Waterways
(7) Danube Region

Labour

The inland waterways employ roughly 130,000 workers, of whom 95,000, it is estimated, can be regarded as workers employed on river craft. In recent years considerable attention has been given to the maintenance of an adequate supply of suitable labour for the waterway system, and the Reich Government has recognized work on inland waterway transport as a profession. Measures have been taken to supervise the education of the children of bargees; a professional training scheme was set up, and in 1938 a three-year apprenticeship system was introduced, leading to examinations for boatswains' and skippers' certificates. Training schools for carrying out this professional education are situated at Mittenburg (Main), Minden (Weser), Schönebeck (Elbe), Ohlau (Oder), Passau (Danube), and Memel.

German Waterways and the Treaty of Versailles

Articles 327–75 of the Navigation Section of this treaty provided for the internationalization of the German stretches of five rivers —the Rhine, Elbe, Oder, Danube and Niemen. For each of the first four of these rivers, the treaty provided for the establishment of an international commission, on which were represented not only the riparian states but also certain non-bordering states.

Composition of International Commission for Control of German rivers under the Treaty of Versailles, 1919 : *number of members*

Rhine		*Danube*	
France	5	Germany	2
Germany	4	Austria	1
Netherlands	2	Czechoslovakia	1
Switzerland	2	Hungary	1
Great Britain	2	Great Britain	1
Italy	2	Jugoslavia	1
Belgium	2	Roumania	1
		Bulgaria	1
		France	1
		Italy	1
Elbe		*Oder*	
Germany	4	Germany	3
Czechoslovakia	2	Czechoslovakia	1
France	1	Poland	1
Great Britain	1	France	1
Italy	1	Great Britain	1
Belgium	1	Denmark	1
		Sweden	1

The German government denounced the navigation sections of the Treaty on 14 November 1936, and at the same time stated that it would enter into bilateral but not multi-lateral negotiations with interested states and would grant them on German stretches of the rivers the same rights as they possessed under the international regime, provided that the states concerned would grant similar rights to German shipping on the non-German stretches.

The internationalization of the Kiel Canal is described on p. 110.

Technical Features

The navigable waterways of Germany may be divided into three categories—natural rivers, regulated and canalized rivers, and canals. The Rhine is the principal example on a large scale of a river which is convenient for navigation without the application of works to regulate the flow. The river has been improved considerably, especially within the last century, by the straightening of the course and by the confinement of the current within a relatively narrow width in order to increase the scour and therefore to maintain the depth. The straightening of the river by cutting through meanders effected great improvements in its use as a navigable stream. Such works, however, belong to a comparatively elementary stage of river improvement.

With the majority of the German rivers more drastic measures have been necessary, involving, as a rule, regulation of the flow.

Some rivers, such as the Weser, which are shallow compared with the Rhine, are unable to carry the large vessel which is so much more economical than the small barge, while other rivers—the Elbe is a notable example—suffer from shallowness in late summer. The usual methods of raising the level of a river are the construction at intervals of weirs with locks, and the creation of storage reservoirs to act as feeders during the times of low water. The river in which the flow is interfered with only to a modest extent is, strictly speaking, 'regulated': where such interference is considerable the river is 'canalized'. The difference is not readily apparent: a leading German hydraulic engineer, O. Franzius, defines the two terms as follows: 'The aim of regulation is to bring about an equalization of the fall over long stretches . . . while in canalization the fall over large stretches is concentrated at various intervals.'

Reservoirs

The increasing regulation of the large rivers of Germany so as to provide greater depths for navigation has demanded the construction of a series of large reservoirs, so that water from regions of adequate rainfall can be stored for release during times of low water in the main stream. Adequate storage is of further value in some districts, where there is a heavy industrial demand for water.

In the highlands of south Germany supplies of water are generally adequate for navigation purposes, and the Rhine possesses ample volume. In the high ground to the south of the Ruhr district water storage, apart from drinking-water supplies, is important, as much for industrial as for navigation purposes. The largest reservoir in this region is the Möhne, on the Möhne, a north-bank tributary of the Ruhr, while the reservoir in the head-waters of the Sorpe, a south-bank tributary, is also important.

Storage for maintaining the river level becomes of cardinal importance in the basin of the Weser. The two principal storage dams are situated on the Eder and Diemel, left-bank tributaries of the Weser, having their sources in the Rothaar Gebirge. The Eder reservoir has ten times the capacity of the Diemel. The water stored by these dams permits a raising of the level in the main stream almost as far as Bremen and compensates for the water taken from the Weser to feed the Mittelland C. As a result, the low-water level of the Weser has been raised by 8 ft. as far as Minden, at the crossing of the Mittelland C.

For the maintenance of an adequate level in the Elbe and Oder the

highlands surrounding the Bohemian massif are of prime importance. Schemes for the improvement of the Elbe require storage also in the middle course—a reservoir was planned near Magdeburg—but it is in the headwaters that the work is most effective. Two important reservoirs are situated at Hohenwarte and Bleiloch on the upper Saale, the principal tributary, above Saalfeld, between the Vogtland and the Frankenwald at the junction of the Thuringian Forest and Fichtel Gebirge. The water stored by these two reservoirs permits the level of the Elbe to be raised by 5·7 ft. On the main river valuable storage is provided by a dam at Pirna, about 15 miles above Dresden. Maintenance of level in the Elbe also involves storage on the Czechoslovakia section of the river, and a dam had been planned at a site near Pürglitz on the Beraun (Berounka) river, which is formed by a combination of headwater streams rising in the Bohemian Forest, and flows eastwards through Plzen (Pilsen) towards Prague. This dam, 1,100 ft. long and 197 ft. high, would impound 500 million cu. m. (17,658 million cu. ft.) in a reservoir 43 miles long.

For the Oder, the south or left-bank tributaries from the Sudeten mountains provide convenient storage facilities, although considerable developments will also involve the use of water from the divide between the Oder and the Vistula drainage near Beuthen and the Polish frontier. Water from the Sudetes is stored in reservoirs at Marklissa and Goldentraum on the river Queis, at Mauer on the Bober, at Breitenhain on the Weistritz and at Ottmachau on the Neisse. A further reservoir was under construction on the Weistritz at Berghof. From the east side of the upper Oder basin water is derived from the Turawa reservoir on the Malapane river which enters the main stream just below Oppeln. A further reservoir is under construction at Stauwerder near the Klodnitz C., to feed both the Oder and the Adolf Hitler C. It will hold the most important place of all in the Oder improvement scheme. (See table on opposite page, which enumerates the largest reservoirs. Many, of course, serve for water supply and power generation.)

Canal Construction

Canals present a variety of problems of a different kind from those associated with the regulation and canalization of rivers. The most important factor governing the choice of the actual route of a canal is the need of keeping to a given level over considerable stretches, without involving cuttings which are too deep, or embankments which are too high. The Ragoser embankment on the Berlin-Stettin

Principal Reservoirs in Germany

River	Location		Area of impounded water (sq. km.)	Height (m.)	Capacity (million cu. m.)
Saale*	Bleiloch	1932	9·2	60	215
Eder*	Hemfurth	1914	12·0	42	202
Glatzer Neisse*	Ottmachau	1933	20	12	143
Möhne	Günne	1912	10·4	32	134
Schluchsee	Schluchsee (A-B. Neustadt)	1932	5	37	108
Rür (Roer)	Schwammenauel (Kr. Schleiden)	1938	4·9	50	100
Sorpe	Körbecke	1934	3·9	60	71
Bober*	Mauer	1912	2·4	50	50
Urft	Heimbach (Kr. Schleiden)	1904	2·2	52	45·5
Oder	Bad Lauterberg im Harz	1934	1·4	52	30
Söse	Osterode am Harz	1932	1·2	56	25
Tauernmoosbach	Uttendorf (Salzburg)	1928	1·4	26	22·4
Lister	Attendorn (Kr. Olpe)	1912	1·7	35	22
Saidenbach	Chemnitz	1933	1·5	48	21·5
Wilde Weisseritz	Lehnmühle (A-H. Dippoldiswalde)	1929	1·2	40	21
Sysdroy-Fluss	Kr. Ortelsburg	1912	4·0	7	20·8
Agger	Dummlinghausen (Oberbergischer Kr.)	1928	1·4	42	20·5
Alle	Friedland, E. Prussia	1924	4·2	14	20
Diemel*	Helminghausen (Kr. Brilon)	1923	1·7	34	20
Wilde Weisseritz	Klingenberg (A-H. Dresden)	1914	1·1	33	16·4
Kerspe	Rönsahl (Kr. Altena)	1912	1·6	29	15·5
Queis*	Marklissa	1905	1·4	40	15
Spullersee	Dalaas (Vorarlberg) Südsperre } Nordsperre }	1926	0·5	33 21	14·4
Schwarzenbach	Forbach (A.-B. Radstatt)	1926	0·7	55	14·3
Ennepe	Schwelm	1904	1·0	40	12·6
Zschopau	Kriebstein (A.-H. Döbeln)	1929	0·8	25	11·6
Passarge	Pettelkau (Kr. Braunsberg)	1916	3·0	13	11·6
Queis*	Goldentraum (Kr. Lauban)	1924	1·3	30	11
Henne	Meschede (Kr. Meschede)	1905	0·9	34	11
Soeste	Thülsfeld (Amt Cloppenburg)	1926	4·6	7	10

* Known to be primarily or partly used for maintaining navigation levels.

From: *Statistisches Jahrbuch für das deutsche Reich, 1938*, p. 4 (Berlin, 1938).

canal, for example, which is 85 ft. high, borders on the present-day maximum. A course which may be perfect from the engineering point of view may be uneconomic owing to the length of the detours or their possible tendency to lead the canal away from large towns or factories. With important canals the present practice in Germany is to connect a trunk waterway with nearby towns by means of short branch canals, instead of carrying the main canal to each centre of population. Thus the new Mittelland C. sends off branches to the

south to reach Osnabrück, Hildesheim, Brunswick and the *Hermann Göring* works at Hallendorf.

The North German Plain clearly has an advantage over the uplands and mountains of more southerly parts of the country in the construction of canals. The advantage is not all one way, however, for the supply of water to the canals of the plain presents a considerable problem. Apart from seepage and evaporation, large quantities are lost in the process of locking in any canal, except where locks of the newest design are used (Plate 116), but the problem of making up the supply of water is usually more serious in the plain. For the Main—Danube C., however, it will be necessary to divert water from the Lech, a tributary of the Danube, in order to feed the summit pool.

Banks and Beds

As far as possible the banks of the river waterways have been left in their natural state, and in some sections, e.g. the Rhine Gorge, the banks are rocky. A great deal of bank reinforcement has been necessary, however, more especially in lower courses, revetment normally being employed. In their lower courses over the North German Plain the rivers have been dyked on a considerable scale, to preserve the low-lying *Marsch* from flooding by river water and by high tides. River dykes are of great importance along the estuaries of the Ems, Jade, Weser and Elbe and are but continuations of the sea dykes of the North Sea coast. The Oder is dyked along most of its lower course, and at intervals higher up. Breaks are possible where the river swings against the sandy hills bordering the flood plain.

The straightening of the lower courses of the main rivers has involved considerable work in dyke building and bank construction. Much of the work of straightening river courses was undertaken in order to reduce the incidence of floods. Wing dams and training walls are employed on an extensive scale to narrow the flow, increase the natural scour and thereby maintain the depth of the river.

On the canals the narrowness of the water surface has necessitated more attention to banks in order to prevent damage by the wash of passing vessels. Concrete has been used in some instances, but for the most part good results have been obtained from reeds planted on the slope of the bank just below the water level to form a dense green sedge. This growth dissipates waves and thus reduces wash. It has been used extensively on the Berlin-Stettin canal. Elsewhere a layer of white peat, 12–20 inches thick, has been found successful. The

banks of the Mittelland C., however, on the other hand, are faced practically throughout with stone pitching, a practice which has been objected to on aesthetic grounds.

The beds of canals have often only a natural seal, and seepage occurs in some, to a varying degree. Extensive sections, especially of the newer and larger canals, have been given a protective layer, however, for seepage raises problems of maintaining the water supply, of possible damage to adjoining land and of damage to the structure of the embankments and cuttings of the canal itself. For these sealing layers clay is the material most often used. On the Rhine-Herne C., for example, the impervious layer is 12–16 inches thick; on the Hohenzollern C. in the most difficult stretches the bed was covered with 21–31 inches of clay, protected by a layer of stone or gravel 16–20 inches thick.

Ice Conditions and Navigation

The cold winters of Germany normally involve the formation of ice on the waterways, and navigation is interfered with, though not to any serious extent. Ice-breakers are used extensively when conditions are suitable. Traffic cannot be maintained when once serious freezing sets in, owing to the impossibility of breaking up thick ice by ice-breakers, and even when ice is broken up, floating ice can be dangerous to vessels. Ice-breakers are of most value towards the end of the freezing period: their primary use then is to break the ice in the lower reaches of a river so as to avoid ice congestion, which can both stop all traffic and cause serious floods. The period during which traffic is stopped owing to ice on waterways in a normal winter is as follows:

East Prussia	3½–4 months
Canalized Oder	2½–3 ,,
Warthe, Netze and regulated Oder	1½–2 ,,
Spree-Oder	1½–2 ,,
Elbe, lower Havel	1–1½ ,,
Mittelland and Dortmund-Ems C., Elbe-Lübeck C.	1–1½ ,,
Weser, Main, Danube	½–1 ,,
Rhine-Herne C.	up to ½ ,,
Rhine	a few days

From official sources.

On the lower Rhine it is the ice brought down by tributaries which may cause trouble.

Over much of the waterway system, therefore, the period of stoppage is short. Its effects upon transport are not very serious, except in unusually cold winters: shippers concentrate on using the

waterways to the full during the favourable months so as to build up stocks, and the peak period for railway traffic does not coincide with the period of freezing in winter, so that if necessity arises goods can be diverted to the railways.

Locks

Dimensions of modern large canal locks often attain: entrance width, 12 m. (39·3 ft.); sill depth, 3 m. (9·8 ft.); length for a barge and tug, 100 m. (328 ft.); length for a train of barges—two 80-m. (262 ft.) barges and a tug—225 m. (738 ft.). The newest locks are structures of considerable size, comparable to many locks in seaports. Their construction, while often involving considerable engineering skill and equipment, presents no serious obstacle. The cost of the work is less onerous in a state which has always paid attention to the needs of large-scale transport connexions throughout the country and in which there is a wide belief that inland waterways justify their cost.

The necessity of locks, however, to overcome differences of level imposes two serious limits on waterway operation arising from the locking of vessels through them. The first is the loss of water and the second is the loss of time. With the simplest form of lock, every time the vessels are passed through in one operation, there is a loss of water, which passes to the lower level, equivalent in volume to the area of the lock multiplied by the difference of level overcome. In much of the North German Plain the water supply of the canals is inadequate for this constant drain, hence a variety of improvements have been developed to reduce the loss of water—thrift locks, storage locks, displacement locks—improvements particularly associated with the name of Professor Proetel. They all involve, in some measure, the employment of chambers near the lock walls so that water can be abstracted from the lock for lowering a vessel and returned for raising a vessel and not lost to the section of the canal below the lock. A second drawback to the use of locks is the amount of time taken in passing a barge train through. In this way not merely is the passage of a barge or train lengthened, but the capacity of a canal is limited. The annual capacity of waterways can be calculated comparatively simply by the length of time required to pass vessels through its locks.

Ship-lifts (*Hebewerke*)

These factors have prompted the development of ship-lifts, which

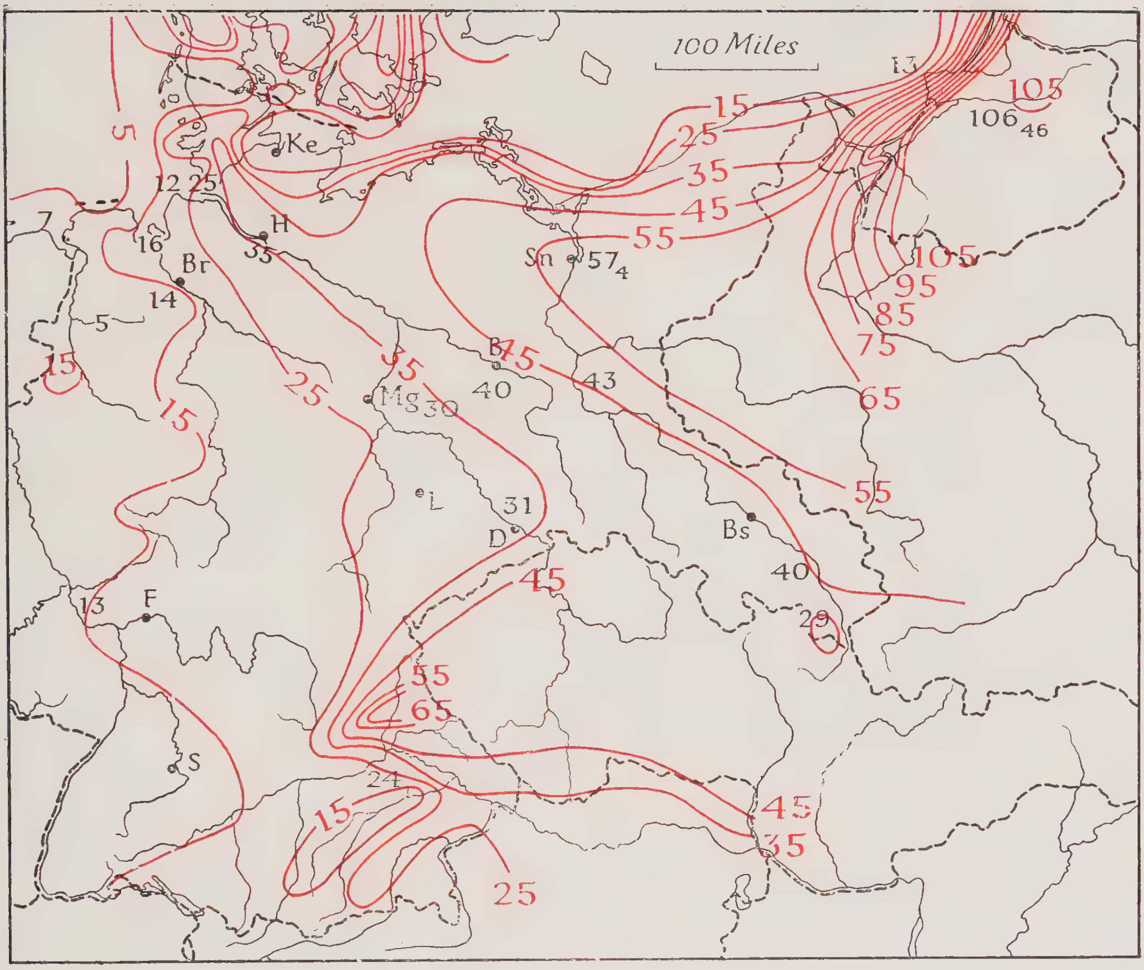

Fig. 123. Number of days with ice on waterways

Based on official sources.

The red lines are generalized isopleths indicating the mean number of days on which ice occurs on the waterways. The larger black figures indicate the maximum number of days at specific points; the small black figures indicate the minimum number of days where this number exceeds nil. B Berlin; Br Bremen; Bs Breslau; D Dresden; F Frankfurt-am-Main; H Hamburg; Ke Kiel; L Leipzig; Mg Magdeburg; Sn Stettin.

involve less loss of water and save a good deal of time. There are three lifts operating in Germany—at Niederfinow on the Hohenzollern C., at Rothensee on the Weser-Elbe (Mittelland) C. and at Henrichenburg on the Wesel-Datteln C. A fourth is projected for the Mittelland C. at Hohenwarthe near Rothensee. These lifts are worked in different ways, but consist in essence of a structure built over the canal at the change in level, and carrying a trough which can be raised or lowered. The trough contains enough water to float a barge; at each end are gates which can be opened or shut. In raising a vessel, the trough is lowered to the low level, the first gate opened and the barge admitted. The trough is then raised, the second gate opened and the barge is passed out into the canal at the higher level.

The Niederfinow lift connects the Hohenzollern C. and the Alte Oder. Raising or lowering a vessel takes 20 minutes compared with two hours necessary to pass through the nearby four locks. The loss of water is obviated—each locking operation in the locks involves the loss of 2,700 cubic m., a serious drain for this canal which has only two feeders—Werbellensee and Staatsee. The lift raises vessels through a height of 118 ft. The trough is 85 m. long, 12 m. wide and 2·5 m. deep; its weight when filled and carrying a barge is 4,250 tons. The trough is suspended by 256 wire ropes, two inches in thickness. By means of counterweights, the operation of raising or lowering requires very little power and a 50 h.p. motor suffices. The superiority of the ship-lift over the lock is evidenced by the fact that the capacity of the Hohenzollern C. at this point is 10,800,000 tons of traffic per annum, while the capacity of the canal by way of the locks is only 2,880,000 tons.

The Henrichenburg ship-lift on the Wesel-Datteln C. raises vessels through a maximum of 52 ft. and an average of 47·6 ft. in 20 minutes. The total weight lifted is 3,100 tons (water and ship 1,540 tons, trough deadweight 800 tons, floats 760 tons). This lift works by means of five floats in shafts 96·8 ft. deep and 30 ft. in diameter. It has proved very successful, although the design has not been employed in other examples.

The Rothensee is the newest of the three lifts, and enables vessels to pass to and from the Weser—Elbe C. (Mittelland C.) and the Elbe over a difference in height up to 59 ft. (see p. 595). The projected Hohenwarthe ship-lift will be constructed a short distance to the east on the other side of the projected aqueduct over the river (Fig. 143).

These lifts have been developed to a greater extent in Germany than elsewhere. Their construction has provided interesting problems for the leading engineering firms, most of which have prepared designs of various types. Two of the chief requirements in the structure of a ship-lift are particularly stable foundations, and a most exact 'fit' between the trough and the waterway at the two levels.

Waterway Craft

In 1939 the German inland shipping fleet (excluding vessels in territories annexed during and after 1938) numbered over 17,000 vessels. The Netherlands fleet, by comparison, numbered 20,000.

German Inland Waterway Fleet, 1939

	No. of vessels	Deadweight tonnage
Self-propelled vessels	5,692	682,780
Dumb barges	12,065	5,785,788
Total	17,757	6,673,304

From official sources.

Self-propelled Vessels

Of the self-propelled vessels, the majority were small—under 200 tons. The total of 5,692 included 772 passenger craft (of which 5 were over 1,000 tons), 2,104 cargo vessels, and 2,387 tugs. Just over half of all these vessels were driven by internal combustion engines, although there was a striking contrast within the types. Nearly all the cargo vessels were motor driven, but nearly three-quarters of the tugs were steam driven. The great majority of all types employed screw propellers, although 420 craft were paddle driven. This number included 301 tugs and 96 passenger vessels. In recent years the internal combustion engine has tended to replace the steam engine to a moderate extent, more especially among cargo vessels and canal tugs. On the Rhine the steam tug is dominant, but on the Elbe the motor tug has made considerable progress, for the supply of oil fuel is cheaper there and the shallowness of the river favours its use. Tugs of considerable power are required on the Rhine, some attaining 2,000 h.p.

Regular Services

A large number of regular services are operated on the waterway system, providing shippers with the opportunity of sending goods from all ports to all ports. It is in this trade that the self-propelled

barge is largely used, especially for general cargo. There are, however, regular services of dumb barges for bulk commodities. Special types of vessels designed to operate both on the waterways and in coastal waters run services from the Rhine ports (i.e. Köln and below) to the German Baltic ports and to Scandinavia.

Barges

On one or two minor canals the towage of barges is effected by electric locomotives operating along the banks (this method is employed on a large scale in France, where the average canal is smaller than in Germany). The overwhelming majority of waterways, however, are used by dumb barges (hauled by tugs) or self-propelled barges. The 12,065 dumb barges included a great variety of craft.

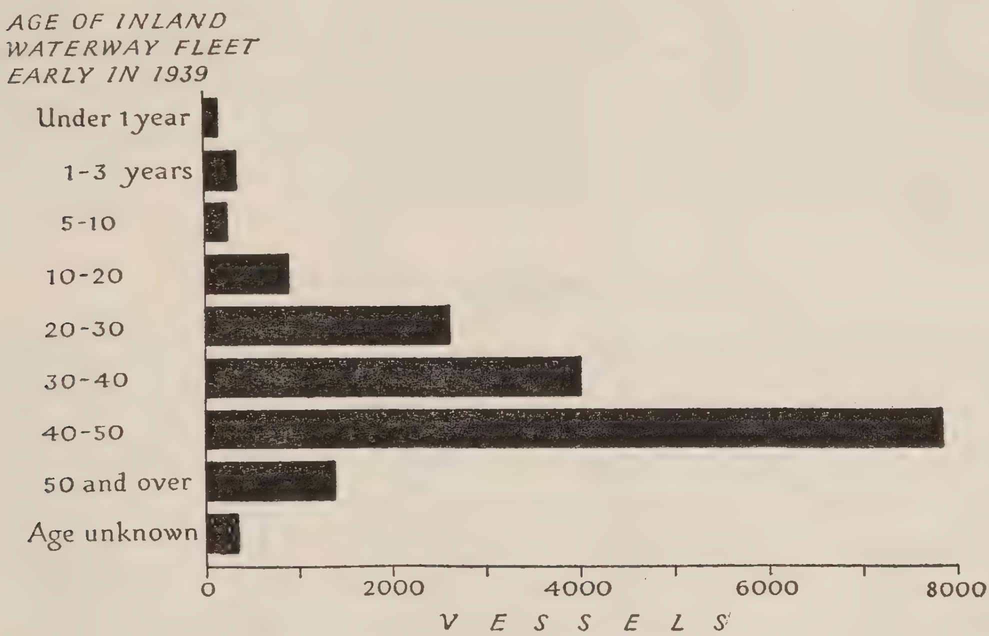

Fig. 124. Age of the inland waterway fleet, 1939

Based on *Wirtschaft und Statistik*, 19th year, no. 7, p. 264 (Berlin, 1939).

The 'age-grouping' in the German fleet is fairly similar to that in the Netherlands fleet. The great predominance, by number, of very old boats is most striking, but it must be remembered that most of the newer vessels are large and that most of the old ones are small. There were still, however, many old barges needing replacement.

Many were of considerable age, although this feature is characteristic of most inland waterway fleets (Fig. 124). Owners have attempted for some years to replace the smaller and unprofitable old vessels by the more capacious types: as a result the number of vessels has been decreasing steadily, since 1930 for example, although the loading capacity has increased. Between 1930 and 1937 the average capacity

of the barges increased from 434 tons to 475 tons, and by 1939 the capacity had increased to 479 tons.

The carrying capacity of a vessel varies with its length and breadth as well as with its draught, so that the stated carrying capacity of a barge is not a precise indication of its draught (or of the navigable depth of a waterway to which the barge is admitted). Broadly speaking, the relationship of draught to capacity of barge may be stated as follows:

Tons	m.	ft.
600	2·0	6·5
1,000	2·5	8·2
1,400	3·0	9·8

The history of the German waterway system is reflected in the types of barge employed; for the barges associated with western Germany differ from those normally found in eastern Germany. Until the opening of the Rothensee ship-lift connecting the Mittelland C. with the Elbe they were largely confined within geographical limits. Now that through passage is possible for barges up to 1,000 tons, interchange takes place between west and east.

Barge types of Western Germany

Name of barge	Length, ft.	Breadth, ft.	Draught, ft.	Deadweight capacity, tons
Rhine	393·7	45·9	9·3	3,500
Rhine	275·6	36·5	8·5	1,700
Rhine	269·0	33·8	8·2	1,500
Rhine	190·3	26·9	6·7	700
Rhine-Herne	262·5	31·1	8·2	1,350
Canal	262·4	29·5	6·5	1,000
River-canal	262·4	34·4	5·2	1,000
Dortmund-Ems	219·8	26·9	6·5	770
Weser	198·5	28·8	6·2	650
Kempenaar	164·0	21·6	8·2	620
Main	164·0	24·6	5·4	420
Maas	152·5	16·5	7·2	360
Flemish	126·3	16·5	7·5	360
Neckar	147·6	22·9	5·4	360
Saar	126·3	16·4	5·9	270
Weser Bock	138·4	21·6	4·4	250
Lahn	111·5	17·0	6·2	220
Mosel	141·0	18·5	4·7	218
Haren	85·3	18·7	5·7	180
Tjalk	82·0	16·4	5·9	140

From official sources.

The most popular barge on the western waterways is the 1,350-ton vessel, especially for coal transport. It can navigate the Rhine, Rhine-Herne C., Main and Neckar, but cannot yet work on the Dortmund-

Ems or Mittelland canals. Two boats were designed for use on the Mittelland C.—the canal and the river-canal, both with a capacity of 1,000 tons. They are of the same length, but the river-canal barge has a shallower draught and a greater beam.

A comparatively small number of exceptionally large barges operate on the Rhine between Rotterdam and Duisburg. They have capacities up to 3,000 tons; the largest barge in use carries 3,600 tons.

Barge types of Eastern Germany

Name of barge	Length, ft.	Breadth, ft.	Draught, ft.	Deadweight carrying capacity, tons
Canal	262·4	29·5	6·5	1,000
River-canal	262·4	34·4	5·2	1,000
Elbe-Plauer (large)	219·8	26·9	5·7	700
Elbe-Plauer	213·2	26·2	5·7	650
Breslau	180·4	26·2	5·7	550
Oder	180·4	25·6	5·6	500
Vistula	180·4	25·6	5·7	500
Saale (large)	170·6	20·8	6·5	450
Saale	167·3	19·7	5·7	400
Berlin	150·9	16·7	5·7	350
Finow (large)	134·5	16·7	5·2	250
Finow	131·2	15·1	5·2	200

From official sources.

Besides these types, a number of the Rhine type of barge (up to a deadweight capacity of 1,200 tons) ply on some of the east German waterways, wherever police regulations admit barges of their dimensions. On the Elbe the length of barge is limited to 249·3 ft. The standard type used on this river is the Elbe-Plauer (large).

Attempts have been made to develop 'standard' vessels for use on the waterways, but the variety of so-called 'standard' vessels is now considerable, and several 'standard' barges may be used on the same waterway. The general aim is to make the 1,000-ton vessel standard for all important waterways, equivalent to the establishment of a depth greater than 8·2 ft. New structures, like the elevator at Niederfinow, the locks at Fürstenberg at the junction of the Oder and Oder-Spree C., and the locks on the Mittelland C., have all been made large enough to accommodate 1,000-ton vessels.

The design of barges in use on the German waterways represents the adaptation of a boat hull to the attainment of maximum loading capacity. The dumb barge, although it requires a tug to be moved, can be constructed with long clear holds and wide hatchways. It is a long box-shaped vessel with ship-shaped ends, and easy to construct. Care is required in loading and unloading, however, for with this type

of vessel, comparatively lightly built for longitudinal stresses, maldistribution of the cargo may cause the hull to buckle. With most dumb barges the maximum deadweight capacity is calculated with practically zero freeboard, the midship section being awash up to the hatch coamings, a reserve of buoyancy being provided by the shear of the hull at each end and by the hatch coamings.

The barges are worked in 'tows' or 'trains' of 4 or 5, an average coal tow on the Rhine having an aggregate capacity of 5,000–6,000 tons.

It is important to bear in mind that a great deal of carriage on the inland waterways of Germany was effected by foreign barges, especially Dutch, the proportion of all carrying services carried out by foreign vessels being approximately one-third. German capital was invested on a considerable scale in the Netherlands barge fleet, and to a smaller extent in the fleets of Belgium and Switzerland. Polish vessels appeared on the upper Oder, Czechoslovak vessels on the Elbe throughout its course, and Netherlands vessels on almost every German waterway. The Danube and the Rhine carried vessels from a great variety of countries, and even British vessels were found (see table on opposite page).

Small numbers of other vessels called at some of these ports—thus 138 Luxembourg vessels called at Duisburg and 20 at Kehl, while one 600-ton Bulgarian barge called at Regensburg.

Waterway Traffic

The tonnage carried on the inland waterways of Germany in 1937 amounted to 133 million tons, or nearly one-third of the tonnage carried by the Reichsbahn—499 million tons. In France, during 1936, the waterways carried only 48 million tons, representing just over one-quarter of the railway tonnage. Apart from a small quantity of through traffic between one foreign country and another, this total of 133 million tons was divided roughly equally between domestic traffic (*Inlandverkehr*) and foreign trade (*Auslandverkehr*). The waterways, therefore, play an economic role which is very different from that of the railways. Only a small fraction of the railway traffic is concerned with foreign trade. The Reichsbahn is dominantly a domestic carrier, like the railway systems in most countries.

The German waterways carried a total traffic not far below the total for comparable waterways in the U.S.A. In 1937, for example, the rivers of that country transported 140·4 million (metric) tons, of

Nationality of Vessels Calling at Certain Inland Waterway Ports, 1937 (*capacity in thousands of tons*)

	Self-propelled		'Dumb' barges	
	No.	Carrying capacity	No.	Carrying capacity
Stettin (Oder):				
German	4,468	922	19,197	7,086
Netherlands	—	—	6	4
Polish	—	—	6	3
Czechoslovak	67	26	291	145
Magdeburg (Elbe):				
German	6,950	2,092	10,494	5,462
Netherlands	16	0	154	101
Czechoslovak	—	—	462	347
Hanover (Mittelland C.)				
German	1,330	493	2,674	1,741
Belgian	4	1	5	5
Luxembourg	2	1	8	4
Netherlands	419	115	271	155
Swiss	20	9	63	58
Duisburg (Rhine and Rhine-Herne C.):				
German	11,752	5,711	30,124	27,669
Belgian	1,346	550	9,219	6,713
French	65	26	2,372	3,194
Netherlands	11,578	3,662	36,404	36,294
Swiss	1,348	624	347	402
Kehl (Rhine):				
German	1,518	920	3,152	3,592
Belgian	307	161	270	302
French	160	56	551	603
Netherlands	1,168	697	1,575	1,754
Swiss	882	435	241	307
Regensburg (Danube):				
German	320	164	735	524
French	—	—	143	103
British	—	—	5	3
Jugoslav	68	41	661	436
Netherlands	96	57	152	102
Austrian	103	66	1,102	704
Roumanian	—	—	177	131
Swiss	—	—	9	6
Czechoslovak	81	40	243	165
Hungarian	12	8	665	414

From: *Die Binnenschiffahrt im Jahre, 1937*, pp. 16–44 (Berlin, 1938).

which the Hudson River accounted for 10, the Columbia and Lower Williamette for 12, and the Mississippi system for 83 (Mississippi, 25; Monongahela, 23; Ohio, 20). In addition, the New York State Barge Canal system carried 6·5 million tons. (On the Great Lakes, traffic amounted to 122·5 million tons.)

The figures for the four years 1934–7 were as follows (in million of tons):

	1934	1935	1936	1937	1938	1939
U.S.A.: traffic on rivers and New York State Barge Canal system	97·7	119·5	143·9	147·7	140·4	163·0
Germany: total waterway traffic	94·9	101·3	116·0	133·1		

From: *Statistical Abstract of the United States 1941*, p. 497 (Washington, 1942); *Die Binnenschiffahrt im Jahre 1937*, p. 13 (Berlin, 1938). For the U.S. figures, short tons of 2,000 pounds have been reduced to metric tons.

The total carried by waterway represented the considerable increase of 22 million tons over the figure for 1927. This increase was not shared equally by the inland and foreign traffic, for the latter increased by a comparatively small figure. Over the period the through traffic (*Durchgangverkehr*) showed the greatest proportionate increase of all, for it doubled, but the total remained small.

Total freight carried on German waterways, 1927, 1937 (*in thousands of tons*)

	1927	1937
Total	*111,448*	*133,080*
Internal traffic	50,874	68,200
Foreign trade	58,923	61,622
Through traffic	1,651	3,258

From: *Die Binnenschiffahrt, etc., 1937*, pp. 12–13.

Principal Commodities Carried

As on the waterways of other countries, the vast majority of the tonnage carried comprises heavy bulk goods which seek, as far as possible, the advantage of cheaper water freights. Over one-half of the total was made up by solid fuels and ores, and the bulk of the remainder by sand, gravel, stone, timber, cereals, petroleum derivatives, etc., iron and steel.

Classification of freight carried, 1937 (*in thousands of tons*)

Coal and coke	48,092	Petroleum, coal and lignite derivatives	2,968
Lignite	3,360	Chemicals, fertilizers	3,520
Ores and pyrites	19,074	Timber	3,301
Sand, gravel	13,916	Worked stone, etc.	2,720
Stone	4,319	Iron and steel, including machinery	5,195
Cereals	6,208		

From: *Die Binnenschiffahrt, etc., 1937*, pp. 12–13.

Over the ten-year period 1927–37 the proportions of the total tonnage borne by these commodity groups showed interesting

Plate 107. Frankfurt-am-Main: Osthafen, looking east

This basin forms part of the principal inland waterway docks of Frankfurt, which lie on the north bank of the Main to the east of the city.

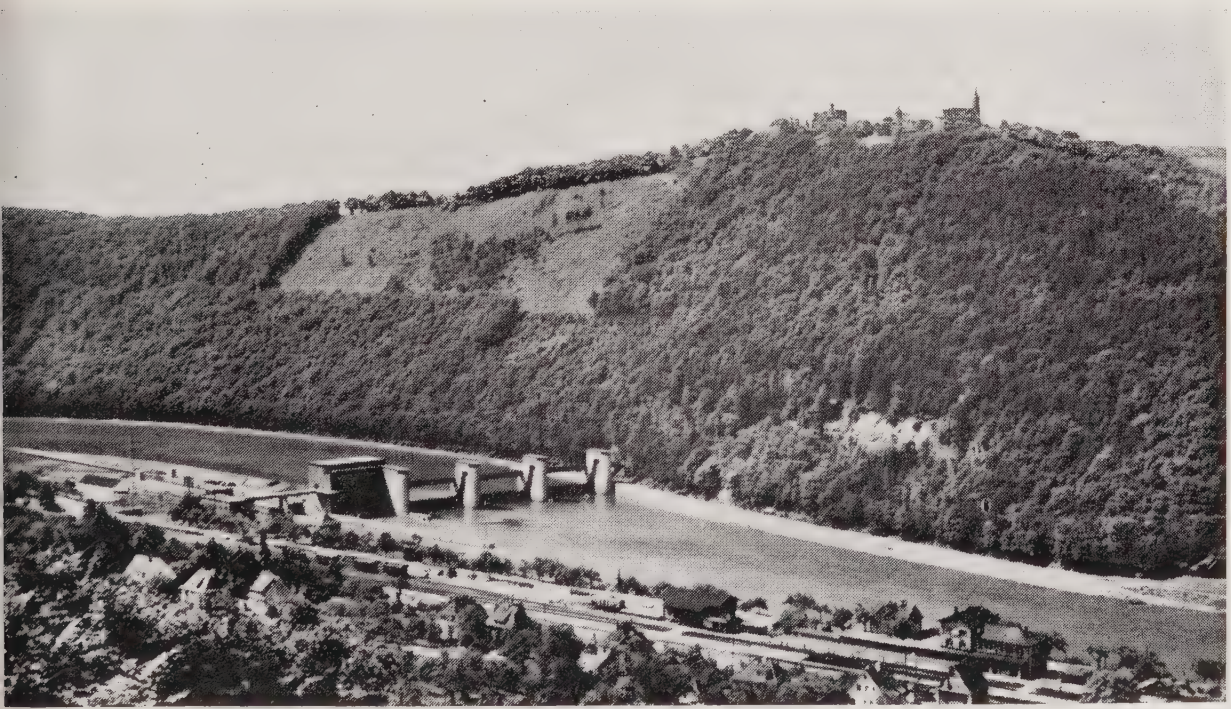

Plate 108. Neckarsteinach: lock and weir on the Neckar

This illustration shows a small part of the regulation works on this river, here flowing in an incised valley through the sandstone foothills of the Odenwald. There are 22 weirs on the Neckar: the highest is at Altbach-Plochingen above Stuttgart, while the Neckarsteinach weir is the fifth above Mannheim. The lock chamber has a drop of 15·4 ft.; it is 360·8 ft. long and 39·4 ft. wide, and can accommodate 1,200-ton barges. In the foreground (north bank) is the double-track railway from Mannheim and Heidelberg to Osterburken.

Plate 109. Kelheim: the Danube and the Ludwigs Canal, looking west

Kelheim is the present limit of navigation on the Danube, and the junction for the Main—Danube C. (under construction). This illustration shows the Danube on the left, and the Ludwigs C. on the right, in the valley of the Altmühl. The rotunda on the hill is the Befreiungs-Halle (Hall of Liberation), at 1,480 ft. altitude, inaugurated in 1863 and bearing symbols of various German victories.

Plate 110. The Danube at Passau

As on the Rhine, most Danube tugs are of the paddle type.

fluctuations, related both to their place in German economy and exports, and to the impact of competition from other forms of transport. The solid fuels showed a very considerable increase and likewise the liquid fuels. Ores and pyrites remained at about the same figure. Stone, sand and gravel showed a large increase, related in part, doubtless, to the extensive programme of road construction

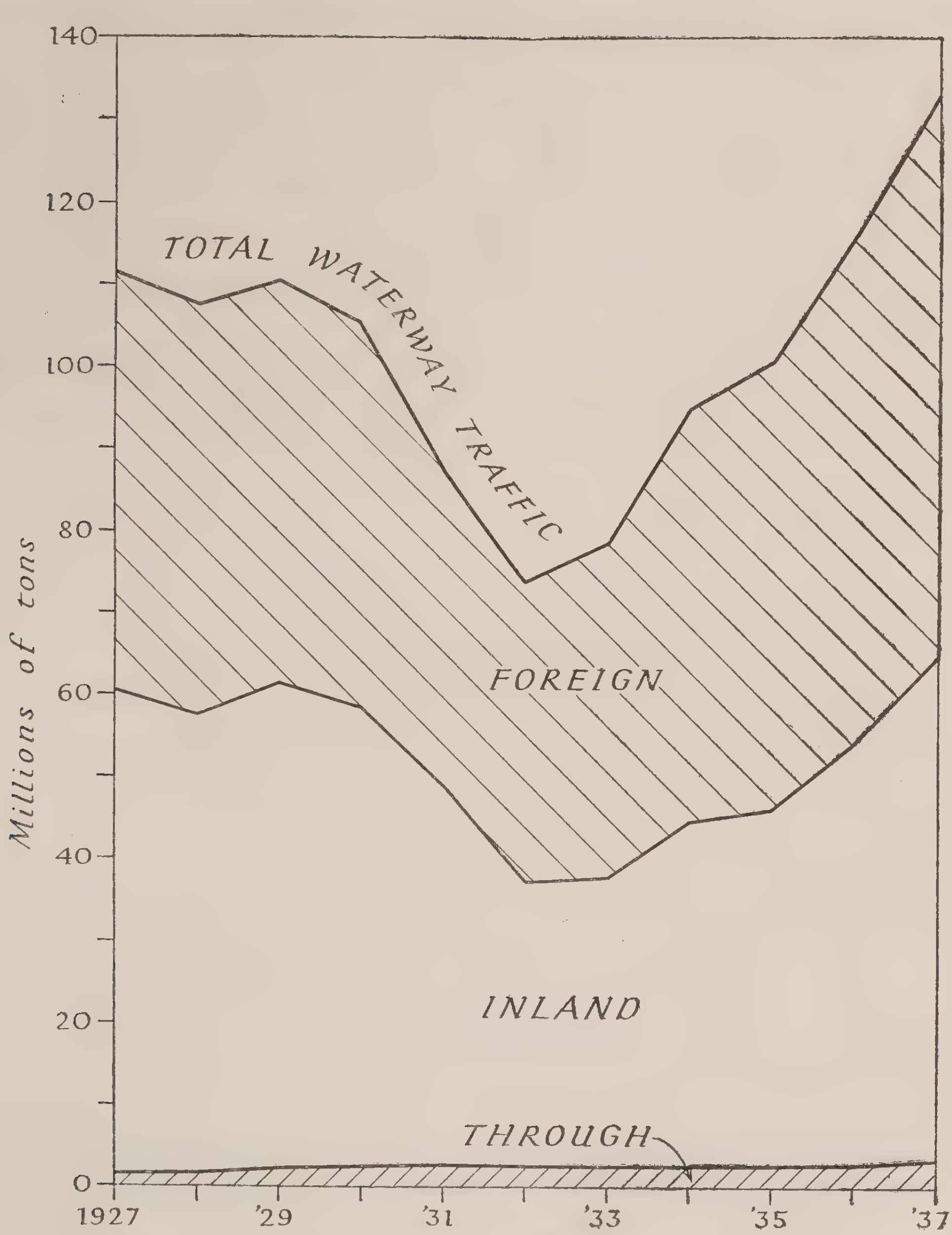

Fig. 125. Waterway traffic, 1927–37
Based on data from *Die Binnenschiffahrt im Jahre 1937*, pp. 12–13 (Berlin, 1938).

carried out in the later years of the period. Chemicals, cereals, timber, and iron and steel did not undergo any marked increase or diminution. The comparison of the group totals for the years 1927 and 1937, however, conceals very great fluctuations within the period,

in conformity with the fluctuation of the totals (Fig. 125). The quantity of iron ore carried in 1932, for example, was less than one-quarter of the quantity carried in 1927 and 1937.

Detailed Statistics of Waterway Traffic

For statistical purposes the *Statistisches Reichsamt* divides the waterways into 62 traffic districts (*Verkehrsbezirke*). These districts comprise partly stretches of waterway and partly waterway ports; they are the fundamental units for the examination of data relating to the tonnage of goods carried. The neighbouring foreign countries which have waterway connexions with Germany are divided into 21 further districts. The commodities handled are classified into over one hundred categories, either of single commodities or groups of related commodities.

The latest year for which these statistics are available is 1937.* The traffic districts are tabulated on p. 547 (foreign) and p. 551 (inland).

Foreign Trade

The total weight of goods in the foreign trade carried by waterway amounted in 1937 to 61,600,000 tons—of which 26,000,000 tons were imports and 35,600,000 tons were exports. The distribution of this trade by country is strikingly unequal and the outward excess is considerable. Both of these facts are explained by the dominance of the Netherlands and Belgium in this trade.

The distribution of this trade by districts within Germany and by commodities is fairly easily described. Of the exports from Germany, over 30 million tons were derived from the lower Rhine and Ruhr, with 17 million tons from Duisburg alone, and included 25·5 million tons of coal and coke. The great bulk of this coal and coke—17½ million tons—moved to the Netherlands under various categories: bunker coal, exports to the Netherlands, and exports to other countries in transit through the Netherlands. Of the 8·5 million tons moving to Belgium, 6 million tons consisted of coal, again, partly an export and partly a supply of bunkers for German liners calling at Antwerp.

The imports by waterway into Germany amounted to 26 million tons, of which 17 million tons were destined for the Ruhr and Lower

* In the geographical description of the waterways on pp. 561–616 more general figures have been employed, giving the totals over longer lengths of waterway, and referring to the year 1937.

Waterway Traffic with Foreign Countries, 1937
(*in thousands of tons*)

Traffic District No.		Imports from	Exports to
44*a*	Alsace	700	1,893
44*b*	Lorraine	—	—
45	Memelland	185	5
46	Danzig	22	26
47	W. Poland	15	—
48	Danish Schleswig	—	—
50*b*	Lithuania	54	1
52*b*	Roumania	306	54
53*a*	Hungary	323	178
53*b*	Jugoslavia	306	43
53*c*	Bulgaria	22	21
54	Czechoslovakia	1,157	643
55	Austria	238	168
56	Switzerland	108	328
58	France (not including nos. 44*a*, 44*b*)	240	458
59	Luxembourg	1	—
60	Belgium	3,939	8,449
61	Netherlands	18,300	23,310
62	Great Britain	36	37
63	Sweden and Norway	1	12
64	Denmark (not including no. 48)	3	36
	Total	25,958	35,663

From: *Die Binnenschiffahrt, etc., 1937*, p. 336.

Rhine, with 8 million tons for Duisburg alone. Of this import, 10½ million tons were ores moving through the Netherlands, while 2 million tons of ores entered by way of Belgium. The seaports which shared in this two-way traffic of coal and ores were principally Rotterdam, followed by Amsterdam, Vlaardingen, Antwerp, and Ghent, while Terneuzen and Flushing shared in the coal trade only.

The Dutch and Belgian ports handled secondary but considerable quantities of cereals, timber, and petroleum derivative imports, and exports of iron, steel and chemicals. The foreign traffic by waterway was dominated, therefore, by the Lower Rhine. Several other minor centres of traffic stand out, however. The most important was the Upper Rhine, which saw the import of ores via Alsace, and the export of German coal to France by way of Strasbourg and to Switzerland by way of Basel. Hamburg handled 1,200,000 tons of waterway traffic in the foreign trade, chiefly on account of Czechoslovakia. South Germany, through the Danube, was able to carry on trade with the countries of south-eastern Europe. Nearly a million tons of imports entered, chiefly cereals, followed by bauxite and timber.

Through Traffic

To a relatively minor extent the waterways of Germany served as a means of transport between neighbouring foreign countries: 3·25 million tons represented the extent of transit traffic (*Durchgangverkehr*). This traffic passed almost entirely along the Rhine.

Through Traffic, 1937 (*in thousands of tons*)

From Alsace to other parts of France	1
,, ,, ,, Belgium	470
,, ,, ,, the Netherlands	253
,, Switzerland to Belgium	48
,, ,, ,, the Netherlands	40
,, Belgium to Alsace	903
,, ,, ,, Switzerland	144
,, the Netherlands to Alsace	1,109
,, ,, ,, ,, Switzerland	288
Total	3,258

From: *Die Binnenschiffahrt, etc., 1937*, p. 324.

Domestic (Inland) Inter-district Traffic

The detailed table of traffic by districts is primarily a reflexion of the economic geography of the country. In the internal traffic carried on the waterways the dominance of the Rhine is less marked than in total waterway traffic. Loadings in the traffic districts of the Lower Rhine account for nearly one-half of the total for Germany, but the inward movement is very much less. The principal item in the outward traffic is coal, which, as in the railway traffic, is a prominent feature of the movement of goods in western Germany.

The largest inward movement for a single traffic district occurs in Berlin, representing the arrival of large quantities of bulky foodstuffs, raw materials and fuels. The outward movement is comparatively small, for there is little which the district can supply in the way of the commodities which normally move by waterway. A similar traffic occurs in south-west Germany, where Mannheim engages in a traffic very similar to that of Berlin, in its heavy inward excess, and amounting to half of the quantity. The chief seaports are among the larger traffic-producing districts, but the relation between inward and outward traffic varies a good deal. Hamburg has an even balance, for its dispatches of imported foodstuffs and raw materials are countered by the movement of chemicals, fertilizers, cement, etc., downstream for shipment abroad. The lower Oder experiences an outward excess of traffic largely owing to the transfer of imports from abroad. Bremen carries on no great long-distance traffic: its heavy inward

shipments are derived largely from stone, gravel and sand cargoes moving down the Weser. The Silesian coalfield has a considerable outward traffic, comprising almost entirely coal. The districts of south Germany all have a large excess of inward movements, derived mainly from the regions of heavy industry. The Danube carries a very small traffic in the domestic trade—it is of considerably more importance for foreign trade.

Inter-district Traffic of Duisburg. The ramifications of waterway traffic in Germany may be illustrated by several examples. The district with the largest movement of all was Duisburg, with 9,500,000 tons (excluding local traffic), roughly balanced in either direction. Outward movements were mainly to districts having connexion with the Rhine—little cargo went as far as Hanover in 1937 and a very small quantity to Berlin. The largest receiver was Mannheim (735,000 tons). Coal and coke formed nearly three-quarters of the outward cargo, and considerable quantities of heavy industrial products went to neighbouring districts in the Ruhr and lower Rhineland. Of the inward cargo, 1,500,000 tons comprised sand, gravel, etc., from nearby districts; there were heavy shipments of pit-props and scrap from the Upper Rhine, and 350,000 tons of iron ore from the Ems-Weser C. in Hanover.

Inter-district Traffic of Berlin. By weight of cargo in both directions Berlin accounted for the second greatest weight in any district, but outward shipments were only one-seventh of the inward. The largest exchange was carried on with the district of the Mark waterways, but much of this was concerned with sand and gravel. Over 1·5 million tons of freight were brought into Berlin from Hamburg, and over a million tons from the Oder and Upper Silesia districts. From the former, coal and coke accounted for two-thirds and were derived largely from Ruhr coal imported at Hamburg coastwise from Emden. Petroleum products and cereals made up much of the remaining cargoes, but there were also fruit, coffee, tobacco, timber, cement, chemicals, pyrites, copper, lead; over 10,000 tons of each of these commodities were carried to Berlin from Hamburg in 1937. From the lower Oder district an inward movement of 750,000 tons of coal accounted for most of the traffic, and the traffic from Upper Silesia included 1,100,000 tons of coal and 90,000 tons of coke.

Inter-district Traffic of the Ems-Weser C. (*in Hanover*) *and Weser-Elbe-C. district* (*No.* 11*d*). This area occupies a fairly central place in the German canal network, at some distance from the larger coalfields and centres of population. In 1937 outward movements were

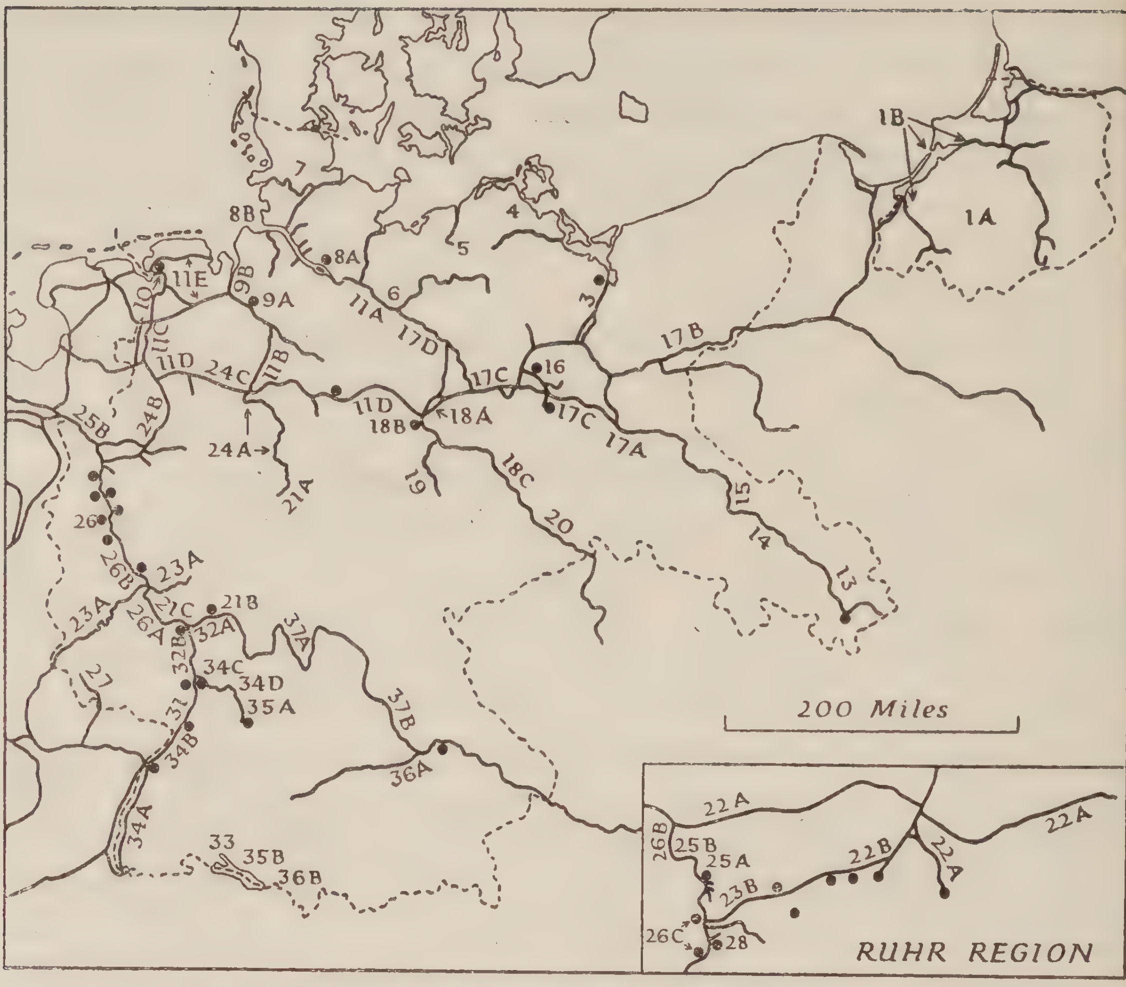

Fig. 126. Waterway traffic districts and chief inland ports

Based on *Die Binnenschiffahrt im Jahre 1937*, p. 3 and map (Berlin, 1938).

The numbers correspond to the numbers of the districts given in the table on p. 551. Some of these 'districts' are stretches of waterway and some are ports. The 33 dots indicate the 33 ports, each of which, in 1937, handled more than 1,000,000 tons of inward and outward cargo together.

1,373,000 tons and inward movements 2,386,000 tons, making it one of the largest traffic-producing districts in Germany. Local traffic in the district was comparatively light. The largest outward movement amounted to 399,000 tons to Duisburg, and comprised almost entirely iron ore. The second largest outward movement amounted to 266,000 tons, and comprised mainly cement and potash fertilizers. Sugar amounting to 74,000 tons was dispatched to most districts of west and south-west Germany. Of the inward traffic the largest item comprised over 1,000,000 tons of coal and coke from the Dortmund-Ems C., while more than 500,000 tons of coal and coke were brought from the other parts of the Rhine-Westphalian region. Secondary shipments inwards included 100,000 tons of iron ore and 32,000 tons of coal from Emden, and 30,000 tons of coal, as well as cereals,

Domestic Inland Waterway Traffic, by Traffic District, 1937

Traffic District		Goods forwarded, in thousands of tons		
		Outwards	Inwards	Local
1*a*.	East Prussia, excl. 1*b*	583	441	100
1*b*.	Königsberg, Pillau and Elbing	510	731	72
3.	Oder and lower branches in Pomerania	2,568	1,433	41
4.	Other waterways in Pomerania	926	1,048	566
5.	Mecklenburg, excl. the Elbe	219	215	87
6.	Elbe in Mecklenburg and Sch.-Holstein	108	101	—
7.	Schleswig-Holstein, excl. Elbe	1,351	1,041	140
8*a*.	Hansestadt Hamburg	4,807	4,037	—
8*b*.	Lower Elbe	117	99	4
9*a*.	Bremischer Staat, to R. Lesum	623	2,163	33
9*b*.	Weser below R. Lesum	471	670	169
10.	Ems and D.E.C. below Papenburg	2,963	2,939	32
11*a*.	Elbe in Hanover, excl. 8*b*	127	237	4
11*b*.	Weser as far as Bremen, excl. 24*a*	1,301	290	108
11*c*.	Ems and D.E.C. in Hanover, excl. 10	113	191	53
11*d*.	E.W.C. in Hanover and W.E.C.	1,373	2,386	20
11*e*.	Other waterways in Hanover and Oldenburg	174	369	52
13.	Upper Silesia	3,239	560	120
14.	Breslau	442	308	—
15.	Lower Silesia, excl. 14	725	386	67
16.	Berlin	1,051	7,243	362
17*a*.	Oder in Brandenburg	371	280	14
17*b*.	Brandenburg	185	171	22
17*c*.	Mark waterways, excl. 16 and 18*a*	2,809	2,218	580
17*d*.	Elbe in Brandenburg	19	115	—
18*a*.	Plauer-Ihle C.	442	188	31
18*b*.	Magdeburg	660	1,082	—
18*c*.	Elbe in Saxony and Anhalt, excl. 18*b*	1,255	1,198	70
19.	Saale and Unstrut	522	356	113
20.	Saxony (Federal State)	1,158	853	157
21*a*.	Werra and Fulda	233	236	211
21*b*.	Main in Hesse-Nassau	324	2,493	68
21*c*.	Rhine in Hesse-Nassau	832	559	117
22*a*.	Lippe C. and D.E.C. south of Lippe	4,259	4,513	535
22*b*.	Rhine-Herne C. in Westphalia	3,340	852	2
23*a*.	Rhine tributaries in Rhine province and Lahn R., excl. 23*b*	228	86	1
23*b*.	Rhine-Herne C., incl. Ruhr, in Rhine province	2,425	893	61
24*a*.	Weser and trib. in Westphalia and Lippe	179	143	—
24*b*.	D.E.C. north of Lippe and Ems in Westphalia	204	467	5
24*c*.	E.W.C. in Westphalia	132	53	—
25*a*.	Walsum	641	129	—
25*b*.	Rhine (right bank) in Rhine prov., excl. 25*a* and 28	2,910	3,205	347
26.	Köln	1,483	696	—
26*a*.	Rhine (left bank) from Nahe R. to Koblenz incl.	241	149	5
26*b*.	Rhine (left bank) below Koblenz, excl. 26 and 26*c*	5,926	823	88
26*c*.	Rhine harbours at Rheinhausen and Homberg	1,394	790	89
27.	Saar in Germany	143	138	122
28.	Duisburg	5,051	4,471	450
31.	Rhine in Bavarian Palatinate	1,962	2,501	289
32*a*.	Main in Hesse	135	179	—
32*b*.	Rhine in Hesse	1,814	2,580	429
33.	L. Constance in Baden	1	42	—
34*a*.	Rhine in Baden from Swiss frontier to Kehl incl.	395	1,067	7
34*b*.	Rhine in Baden from Kehl to Mannheim excl.	407	2,274	—
34*c*.	Mannheim	623	3,368	—
34*d*.	Neckar in Baden and Hesse	153	105	11
35*a*.	Neckar in Württemberg	544	703	63
35*b*.	L. Constance in Württemberg	104	63	63
36*a*.	Danube in Bavaria and Württemberg, excl. 37	26	28	25
36*b*.	L. Constance in Bavaria	—	—	—
37*a*.	Main in Bavaria and Baden, excl. 37*b*	821	1,220	352
37*b*.	Ludwigs C.	20	18	15
	Total	68,200	68,200	

From *Die Binnenschiffahrt, etc., 1937*, p. 324.

D.E.C.: Dortmund-Ems Canal; E.W.C.: Ems-Weser Canal: W.E.C.: Weser-Elbe Canal. The two latter waterways make up what is usually known as the Mittelland Canal. The Lippe C. is described elsewhere in this account as the Wesel-Datteln C. and Datteln-Hamm C. Under the rivers named the navigable tributaries are included. The traffic in the third column is included in the figure given in each of the other two columns.

from the Weser ports. There was little exchange of traffic with Hamburg. Clearly the main function of the connexion between the Hanover district and the rest of the waterway system by the Mittelland C. was to link the area with the Ruhr and Lower Rhine.

Local Traffic

Of the total 68,200,000 tons of freight which is dispatched (and received) in the domestic traffic, nearly 6,500,000 tons are distinguished

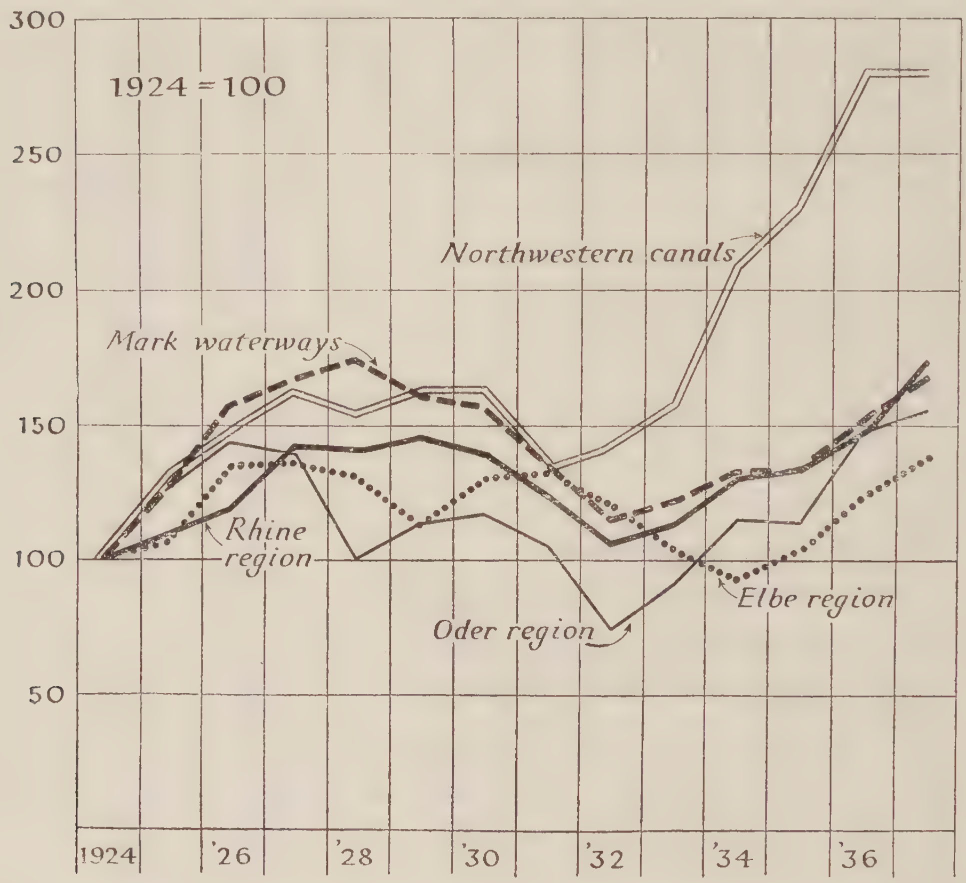

Fig. 127. Growth of waterway traffic, by region, 1924–37

Based on *Wirtschaft und Statistik*, 19th year, no. 5, p. 182 (Berlin, 1939).

In 1937 the Rhine, Elbe, Oder and Mark waterways had recovered their volume of traffic, compared with the figures for the active years 1927–30; the north-western canals, however, attained in 1936 and 1937 nearly double the traffic of 1930—a reflection of the expansion of traffic on the Dortmund-Ems C. and of the extension eastwards of the Mittelland C.

as *Lokalverkehr*, i.e. traffic which is consigned to destinations within the traffic district in which it originates. It is usually greater in traffic-producing districts which cover a good deal of territory, such as the Mark waterways (580,000 tons) or the minor waterways in Pomerania (566,000 tons), but considerable quantities of this short-

distance freight appear elsewhere, e.g. Berlin (362,000 tons), Duisburg (450,000 tons), and the Lippe C. or Wesel—Datteln C. (535,000 tons). The quantity is normally only a small proportion of the total for the district, but on the Werra and Fulda, on the Saar, on Lake Constance and on the Ludwigs C., it forms a high proportion.

Rail-water and Water-rail Interchange

The two transport systems for the carriage of goods inter-connect to a considerable degree. In 1937, 36 million tons of goods were transferred from rail to barge, and 15 million tons from barge to rail. The total figure of goods which are interchanged between the two forms of transport would be something approaching the addition of 36 and 15 million tons (it is probable that some consignments interchange more than once). This quantity is a very considerable fraction of the entire weight of goods carried on the waterways—133 million tons, but a small fraction of the total carried on the railway system—482 million tons.

The railways feed the waterways to the extent of twice as much as the waterways feed the railways. The difference is more than accounted for by the movement of coal, coke and lignite—24·5 million tons were loaded from truck to barge, but only 6 million tons in the opposite direction. In this interchange traffic, therefore, a dominant part is played by the railways in moving coal, etc., from points of origin to the nearest waterway shipping point. The railways play a similar rôle with stone, cement, salt, and potash and nitrogenous fertilizers.

With other commodities, the reverse takes place—cargoes are moved by barge from the point of origin, frequently a seaport, as far as possible before being passed to the railways for final distribution. Such items were wheat, maize and other cereals, pyrites, petrol, earth, sand and gravel, alumina and bauxite. Some commodities, finally, are transferred on a considerable scale both from barge to rail and rail to barge—raw sugar, iron and manganese ores, lignite briquettes, other mineral raw materials, and sawn timber. Among heavy iron and steel products, the less valuable, such as pig iron and scrap, move more from barge to rail. Bar iron, tubes, etc., usually begin their journey by rail.

The following table shows the principal commodities which undergo interchange of transport. Those listed account for about 90% of the total.

Exchange Traffic of Goods between Waterways and Railways, 1937
(*in thousands of tons*)

Commodity	Total Unloadings	
	From rail to barge	From barge to rail
Wheat	150	316
Maize	23	579
Other cereals	96	301
Raw sugar	217	100
Iron and manganese ores	536	879
Pyrites	9	260
Coal	22,223	3,236
Coal briquettes	236	203
Coke	2,170	979
Lignite briquettes	3,235	1,611
Benzine (petrol)	6	232
Worked and un-worked stone	645	73
Earth, sand, gravel	229	2,030
Cement, mortar	418	70
Salt	444	46
Alumina, bauxite	3	602
Other mineral raw materials	477	301
Potash fertilizers	882	9
Nitrogenous fertilizers	270	27
Sawn timber	318	194
Pig iron and alloys	17	289
Iron and steel scrap	285	794
Bar iron and steel, etc.	300	101
Iron and steel tubes	235	32
All commodities	35,967	15,577

From: *Die Binnenschiffahrt, etc., 1937*, p. 64 (Berlin, 1938).

The distribution of this traffic by port is not markedly different from the distribution of all waterway traffic by port, but it is by no means identical. Thus the canal ports of the mineral areas dominate this exchange traffic—Duisburg-Ruhrort and Wanne-Eickel in the Ruhr, Kosel in Silesia, or Wesseling near the lignite beds in the west of the Rhine province. In such ports the movement is mainly from rail to waterway. Berlin is of small importance, for most of its enormous rail and water-borne trade is concerned with direct consumption within the city. The heavy waterway traffic of the seaports is not represented in any scale, also, for most of their traffic is from barge to ship and vice versa.

In general, the exchange traffic appears as representative of the consumption and industries of the area adjacent to each port. Thus Dresden distributes by rail cellulose brought by waterway, and dispatches by waterway paper brought by rail. Ports on the middle Elbe distribute by rail minerals, maize and oilseeds brought by waterway, and dispatch by waterway fertilizers brought by rail. Coal is the most frequent cargo of importance and occurs more often as a water to rail exchange, for it is brought by waterway from the few producing areas, and distributed widely over regions such as south

Germany. The table on page 556 shows the exchange movements at the 52 ports which handled, in this connexion, more than 75,000 tons of cargo in 1937. The published returns include, but do not separately distinguish, the traffic which relates to foreign trade. The greater part of the exchange traffic at Duisburg-Ruhrort, for example, is in the foreign trade. With most of the other ports this does not occur to any great extent, and the statistics of this traffic reflect mainly the working of the internal economy of Germany.

Traffic Density by Ton-Kilometre

A further index to the relative importance for traffic of each waterway is provided by the figure of ton-kilometres. Each total is obtained by multiplying the number of tons carried on a waterway by the distance, in kilometres, which each ton is carried. The resulting figure is of value mainly as an index of the intensity of use. It takes into account all traffic—long, medium, and short-distance, and is some index to the capacity of a waterway. Geographically, the ton-kilometre figures give little information, however.

An elaboration of this index is the density expressed by the number of ton-kilometres per kilometre of length, or average density of traffic use over the whole waterway.

On the basis of these figures, the Rhine waterway is outstanding, for the great weight of cargo shipped on the Rhine is mostly carried for considerable distances. The Elbe shows figures not dissimilar from those of the Oder; both are exceeded by those of the north-west German waterways.

Traffic Density on German Waterways, 1936

	Length, km.	Ton-km. (millions)		Traffic density, thousand ton-km. per km. length	
East Prussian waterways	524	127·8		186·4	
Oder region	1,102	2,514·0		2,182·3	
Oder (Kosel to Stettin)	640		2,315·7		3,618·2
Mark waterways	905	1,262·6		1,395·2	
Elbe region	1,542	3,288·5		2,132·6	
Elbe (Czechoslovakian frontier to Hamburg)	622		3,052·8		4,908·1
Ems-Weser region	1,596	4,237·1		2,648·3	
Rhine-Herne C.	51		527·7		10,347·6
Dortmund-Ems C. (from Bergeshövede to Herbrum)	105		765·5		7,290·2
Ems-Weser C. (to Minden)	102		402·7		3,948·2
Weser-Elbe C.	134		300·6		2,243·1
Rhine region	1,772	14,372·6		8,111·0	
Rhine	713		13,889·7		19,480·6
Danube	213	126·9		595·7	
All waterways	7,654	25,929·2		3,368·2	

From: *Die Binnenschiffahrt, etc., 1937*, pp. 14–15.

Exchange Traffic between Waterways and Railways, 1937
(*in thousands of tons*)

Port	From Rail to Waterway			From Waterway to Rail		
	Total	Chief item		Total	Chief item	
Kosel (Oder)	3,335	Coal	3,062	473	Ores	285
Breslau ,,	70	Coal	39	38	Maize	10
Maltsch ,,	595	Coal	236	27	Oilseeds	7
Stettin ,,	164	Lignite Br.	112	14	Coal	10
Stepenitz ,,	16	Raw sugar	9	61	Coal	37
Berlin (-Mitte, -West, -Teltow-kanal)	8	N.F. metal goods	3	144	Coal	94
Fürstenberg (Oder)	38	Lignite Br.	11	95	Alumina	56
Dresden (Elbe)	87	Paper, Pulp	40	68	Cellulose	14
Riesa ,,	271	Lignite Br.	119	195	Cellulose	30
Dessau ,,	35	Nitr. fert.	30	217	Alumina	62
Aken ,,	127	Nitr. fert.	72	42	Mineral R.M.	16
Barby ,,	122	Pot. fert.	79	33	Maize	11
Schönebeck (Elbe)	466	Pot. fert.	285	63	Coal	18
Magdeburg ,,	198	Salt	92	123	Oilseeds	22
Hamburg ,,	308	Coke	239	18	Stone	6
Münden (Weser)	195	Chemicals	145	6	Rye	2
Bodenwerder-Linse (Weser)	88	Pot. fert.	50	1	—	—
Minden* (Weser)	79	Coal	46	29	Rice	13
Osnabrück (Ems-Weser C.)	20	Bar steel, etc.	17	140	Ores	97
Brunswick (Weser-Elbe C.)	130	Salt	63	106	Coal Br.	34
Hanover ,,	86	Pot. fert.	37	130	Coal	100
Misburg ,,	169	Pot. fert.	107	38	Coal	31
Hildesheim (W.E.C. branch)	220	Pot. fert.	123	55	Coal	55
Dortmund (Dortmund-Ems C.)	235	Coal	202	—	—	—
Saerbeck ,, ,,	94	Coal	57	7	Meal	7
Hamm (Datteln-Hamm C.)	258	Cement	182	66	Sulph. acid	15
Wanne-Eickel (Rhine-Herne C.)	1,951	Coal	1,809	95	Pit props	44
Kehl (Upper Rhine)	228	Timber	94	1,044	Coal	34
Karlsruhe ,,	201	Timber	77	2,314	Coal	1,067
Mannheim ,,	79	Cement	16	1,412	Coal	522
Ludwigshafen (Upper Rhine)	713	Coal	234	845	Lignite Br.	272
Worms (Middle Rhine)	31	Sand, gravel	24	128	Coal	50
Gernsheim ,,	7	Stone	7	205	Sand, gravel	144
Mainz ,,	20	Scrap iron	13	345	Coal	150
Bingen ,,	53	Stone	25	95	Ores	22
Oberlahnstein ,,	318	Ores	299	106	Sand, gravel	81
Bendorf ,,	106	Mineral R.M.	97	—	—	—
Brohl ,,	126	Stone	103	8	Mineral R.M.	4
Beuel ,,	147	Stone	136	5	Coal	2
Wesseling ,,	2,853	Lignite Br.	2,839	31	Salt	17
Köln (Lower Rhine)	1,283	Coal	805	369	Alumina	275
Neuss ,,	255	Coal	193	144	Sand, gravel	97
Düsseldorf ,,	175	Coal	168	214	Sand, gravel	155
Duisburg-Ruhrort (Lower Rhine)	17,717	Coal	15,464	2,829	Sand, gravel	890
Orsoy (Lower Rhine)	734	Coal	712	—	—	—
Wesel ,,	3	Steel	2	164	Sand, gravel	156
Heilbronn (Neckar)	160	Timber	88	359	Raw sugar	32
Aschaffenburg (Main)	58	Pit props	40	541	Coal	369
Hanau ,,	168	Pot. fert.	86	47	Coal	10
Frankfurt a. Main	50	Mineral R.M.	15	523	Coal	96
Regensburg (Danube)	316	Salt	25	798	Maize	259
Passau ,,	24	Salt	19	99	Wheat	52

From: *Die Binnenschiffahrt, etc., 1937*, pp. 45–63 (Berlin, 1938).

* Two harbours, one above and one below the lock.

R.M.: Raw materials; N.F.: Non-ferrous; Br.: Briquettes.
'Alumina' includes Bauxite and Cryolite.

Waterway Ports

The German waterway traffic returns specify 134 places as 'the most important harbours'. A few of these are ports of no great consequence, but the majority handle considerable quantities of

cargo, and only 19 of the 134 have an aggregate of incoming and outgoing cargo of less than 100,000 tons annually. Most of the ports and most of the large ports are found in the two regions of the *Rheingebiet* and the *Nordwestdeutsches Wasserstrassengebiet*. For their length, the Elbe and the Oder are distinguished by the paucity of large ports along their courses. The ports which handled more than 100,000 tons of cargo in 1937 were the following:

East Prussian Waterways: Ragnit, Tilsit, Königsberg.

Oder Region: Kosel, Breslau, Maltsch, Landsberg, Stettin, Swinemünde.

Mark Waterways: Berlin, Fürstenberg, Niederlehme, Rüdersdorf, Eberswalde and Finow, Zehdenick, Oranienburg, Hennigsdorf, Potsdam, Ketzin, Brandenburg, Genthin.

Elbe Region: Dresden, Riesa, Piesteritz, Dessau, Aken, Barby, Schönebeck, Magdeburg, Tangermünde, Hamburg, Halle, Lübeck, Itzehoe, Kiel.

North-west German Waterways: Münden, Minden, Bremen, Brake, Nordenham, Wesermünde, Bremerhaven, Oldenburg, Osnabrück, Hanover, including Brink, Misburg, Hildesheim, Peine, Brunswick, Dortmund, Datteln, Münster, Saerbeck, Emden, Ahlen, Hamm, Lünen, Flaesheim, Hamm-Bosendorf, Hervest, Castrop-Rauxel, Herne, Wanne-Eickel, Gelsenkirchen, Bottrop, Essen, Oberhausen, Mülheim a.d. Ruhr.

Rhine Region: Kehl, Karlsruhe, Mannheim, Ludwigshafen, Worms, Gernsheim, Mainz, Wiesbaden, Budenheim, Bingen, Braubach, Oberlahnstein, Koblenz, Bendorf, Mühlhofen-Engers, Neuwied, Andernach, Brohl, Linz-Linzhausen, Beuel, Bonn, Wesseling, Köln, Leverkusen-Monheim, Neuss, Düsseldorf, Krefeld-Uerdingen, Rheinhausen, Duisburg, Homberg, Walsum, Orsoy, Rheinberg-Ossenberg, Wesel, Emmerich, Spyck, Kleve, Heilbronn, Jagstfeld, Würzburg, Aschaffenburg, Hanau, Offenbach, Frankfurt a.M., Saarbrücken.

Danube Region: Regensburg, Passau.

Counting Mannheim and Ludwigshafen together, there were thirty-three waterway ports which handled over 1,000,000 tons in 1937 (Fig. 126). Duisburg was pre-eminent; Mannheim-Ludwigshafen, Hamburg and Berlin were fairly close to each other, and considerably ahead of Emden, Gelsenkirchen and Dortmund. Berlin was the third largest 'inland' port, but the fourth largest for inland waterway traffic, owing to the importance of barge traffic at Hamburg. Duisburg handled in 1937 about 40% more cargo than all the sea-

borne cargo moving, in both directions, through Hamburg. Inland waterway cargoes at Mannheim-Ludwigshafen, at Hamburg and at Berlin exceeded the total sea-borne cargo handled at any seaport except Hamburg (see p. 4). Only seven German seaports handled more than 1,000,000 tons of sea-borne cargo.

Waterway ports handling more than 1,000,000 *tons of incoming and outgoing cargo*, 1937 (*in thousands of tons*)

Port	1937	1932	1927
Duisburg	34,297	15,496	33,567
Mannheim	5,593	4,326	6,749
Ludwigshafen	5,372	2,249	4,004
Hamburg	9,990	8,278	10,254
Berlin	8,387	5,639	9,531
Emden	5,622	3,040	3,626
Gelsenkirchen	5,622	3,025	3,272
Dortmund	5,106	2,050	4,122
Bottrop	2,636	3,398	4,758
Essen	2,509		
Kosel	3,854	1,666	3,288
Stettin	3,880	2,190	2,756
Köln	3,408	2,460	2,420
Rheinhausen, nr. Düsseldorf	3,025	802	2,641
Frankfurt a.M.	2,956	1,920	2,971
Wesseling	2,895	2,095	2,085
Karlsruhe	2,874	2,372	2,100
Walsum	2,830	1,021	2,990
Wanne-Eickel	2,820	2,188	2,701
Düsseldorf	2,755	1,545	1,696
Bremen	2,640	1,593	2,241
Mainz	2,534	1,238	2,229
Homberg	2,386	1,301	1,045
Kehl	2,137	1,839	992
Magdeburg	1,800	1,374	1,360
Herne	1,745	745	981
Heilbronn	1,306	191	185
Regensburg	1,277	448	538
Peine	1,270	220	—
Neuss	1,227	947	827
Neuwied	1,147	396	—
Leverkusen-Monheim	1,040	393	545
Krefeld-Uerdingen	1,003	524	945
Niederlehme	1,003	159	567

From: *Die Binnenschiffahrt, etc., 1937*, p. 5.

The ports of the Ruhr and lower Rhineland district do not exhibit any striking change over the ten-year period. Duisburg, Bottrop, Essen, Rheinhausen, Wesseling, Wanne-Eickel, and Krefeld-Uerdingen handled a modest increase of tonnage, while Gelsenkirchen, Dortmund, Köln, Düsseldorf, Homberg, Herne, Neuss and Leverkusen-Monheim showed quite considerable increases. Of the seaports, Hamburg showed a decline and Bremen an increase; Emden and Stettin handled considerably heavier tonnages. On the upper

Rhine the total for Mannheim and Ludwigshafen was not very different, a decline at Mannheim being offset by a corresponding increase at Ludwigshafen. Kehl showed a striking expansion of traffic, likewise Neuwied on the Rhine below Koblenz, and Heilbronn, which gained from the improvement of the Neckar. The eastward extension of the Mittelland C. is reflected in the use of Peine. Niederlehme, on the southward extension of the Oder-Spree C. to the Notte, Damme, and Spree navigation, experienced a doubling of traffic. The increase in the cargoes on the Danube is shown in the figures for Regensburg.

Waterway Rates

The cost to the user of the inland waterways consists of towing fees, carrying charges and, in the case of a canal, canal dues (see p. 522). Carrying charges are not standardized. Towing fees are based on a fixed rate per ton-kilometre plus a surcharge varying according to the class of goods. Canal dues are based upon a classification of goods (with special reference to value), weight and distance (without regard to the number of locks passed). In the goods classification of the new canals commodities like cotton, fruit, and petroleum, together with manufactured articles, pay the highest rate; iron and steel tubes, foreign timber, jute and raw sugar are examples of goods in the second highest category; in the third category are raw iron and cement; in the fourth are pitprops; in the fifth are fertilizers, ores, sugar-beet, stone and bricks; while the lowest rate of all is charged to potassium fertilizers for consumption within Germany. On the older canals rates are lower and are divided into four categories only.

Canal dues and towing fees in west Germany were regulated by the government in 1937.

On the rivers rates were more variable and showed marked fluctuations from one year to another. Periodic changes in river level introduce considerable complications owing to the limitations which they impose upon the availability of the larger craft. The Rhine, furthermore, is concerned much more with foreign trade than are most German waterways, and its traffic is more sensitive to changes in world prosperity.

In general, the question of waterway rates in Germany is highly involved. The trend is in the direction of standardization. Just as the physical equipment of the waterways is not completely co-ordinated, however, so also transport costs still show signs of long-standing

conflict and of the demands of special interests. The completion of the Mittelland C. connexion between the Rhine and the Elbe brought some of these conflicts to the fore. The dues on the canal were doubled on the section between Misburg and Magdeburg, except for through traffic to the sea via Hamburg and for the main products carried from east to west, such as grain, milled cereals and sugar. This doubling of normal rates had the effect of protecting Hamburg and the Rhine—Sea shipping traffic, although not completely, for Ruhr coal destined for Berlin has shown a tendency to change from the Rhine—Sea or Emden—Elbe route to the canal (see p. 97).

Further, the state secretary of the Transport Ministry was reported in 1937 to have said that two of the objects which must be kept in mind in fixing rates on the canal were the protection of Upper Silesia and the protection of the Reichsbahn. Mining interests in Upper Silesia had long feared that the construction of the canal would favour Ruhr coal to their disadvantage.* The shortage of east-bound cargo space, however, had, up to 1939, prevented the threat from becoming serious.

An example of the high rates on the canal appeared in connexion with the shipment of clay and kaolin from the Halle district to ceramic works near Bonn. The cost of shipment via the Mittelland C. was RM.13.65, compared with RM.13.50 by rail and only RM.10.00 via Hamburg, the coastal route, Antwerp and the Rhine.

GEOGRAPHICAL DESCRIPTION

The number of waterways which are navigable in some degree is very large, but many of them are small, out of date, or little used. The published traffic returns list 88 different canals and rivers. A number of these are isolated estuaries. In some cases what functions as one waterway consists of a number of separate entities. The following description covers 36 waterways and major sections of waterways, grouped under 'western Germany', 'south Germany', 'north-western Germany', and 'north-eastern Germany'. The waterways described are the most important in the country, and provide transport connexions over much of its area.

The maximum capacity of the barge which can traverse each waterway is given. The figures are derived from the latest authorities available, but it is not possible to give an exact or final statement, for two reasons. (1) The capacities stated in this account refer generally to the position in 1939 or to the position assumed to follow the completion of improvements then being undertaken. The position is never static

* See p. 521.

Plate 111. Oberhausen: the Rhine-Herne Canal
The bridge in the background carries the Köln—Berlin autobahn

Plate 112. Gelsenkirchen: Grimberg Harbour on the Rhine-Herne Canal
This harbour is operated by the *Deutscher Eisenwerke A.G.*

Plate 113. Junction of Dortmund-Ems and Ems-Weser (Mittelland) canals
This junction is situated near Bergeshövede.

Plate 114. Ems-Weser (Mittelland) Canal
This illustration shows an aqueduct near Seelze, a few miles west of Hanover.

—widening or deepening is always in progress at some point. (2) Most authorities quote the 'maximum' capacity of the barge which can be admitted to a waterway, but in certain instances it is not clear whether this capacity is fully loaded or not. When the width of locks is sufficient, partly loaded barges sometimes use a canal which they could not traverse at the fully loaded draught. On the Dortmund-Ems C., for example, the maximum capacity was 750 tons in 1938 (works then in progress would raise it to 1,500 tons), but most vessels using the canal were 1,000-ton craft not fully loaded. On the Rhine-Herne C., the maximum was 1,350 tons, but the average load was about 600 tons.

It is important to remember that some waterways are known by more than one name, and that a waterway may be known also by the name of a series of which it forms a part. Thus the Wesel-Datteln and Datteln-Hamm canals are often called the Lippe Canal or Lippe Seiten Kanal; the Elbe-Lübeck may be called the Elbe-Trave Canal; and the waterways connecting Berlin and Stettin, chiefly the Hohenzollern Canal and the river Oder, are often referred to as the 'Berlin—Stettin Ship Canal'. The two constituent parts of the Mittelland Canal are widely known as the Ems—Weser and Weser—Elbe canals, partly because the former was in operation some years before the latter. The Ihle and Plauer canals which lead from the Elbe near Magdeburg to the Havel are sometimes called the 'Elbe—Havel Canal'.

The Waterways of Western Germany

The greatest artery of water-borne traffic in Europe traverses western Germany. The Rhine offers a waterway for inland navigation of unexampled convenience, and in its lower stretch passes through the most highly developed industrial region in the country. It is convenient to consider in this section, also, the Mosel, a left-bank tributary, together with its tributary, the Saar; the right-bank tributary, the Lahn; and the two canals which take off from the right bank to traverse the Ruhr coalfield—the Rhine-Herne C. and the Wesel-Datteln C., together with the prolongation of the latter, the Datteln-Hamm C. Datteln is a canal junction of the greatest importance, for here the east-west waterways from the Rhine are crossed by the north-south waterway of the Dortmund-Ems C., which now serves two functions—it connects the Ruhr with the North Sea at Emden, and opens into the Mittelland C. system leading eventually to Berlin. The large right-bank tributaries, the Neckar and Main, are described under 'south Germany'.

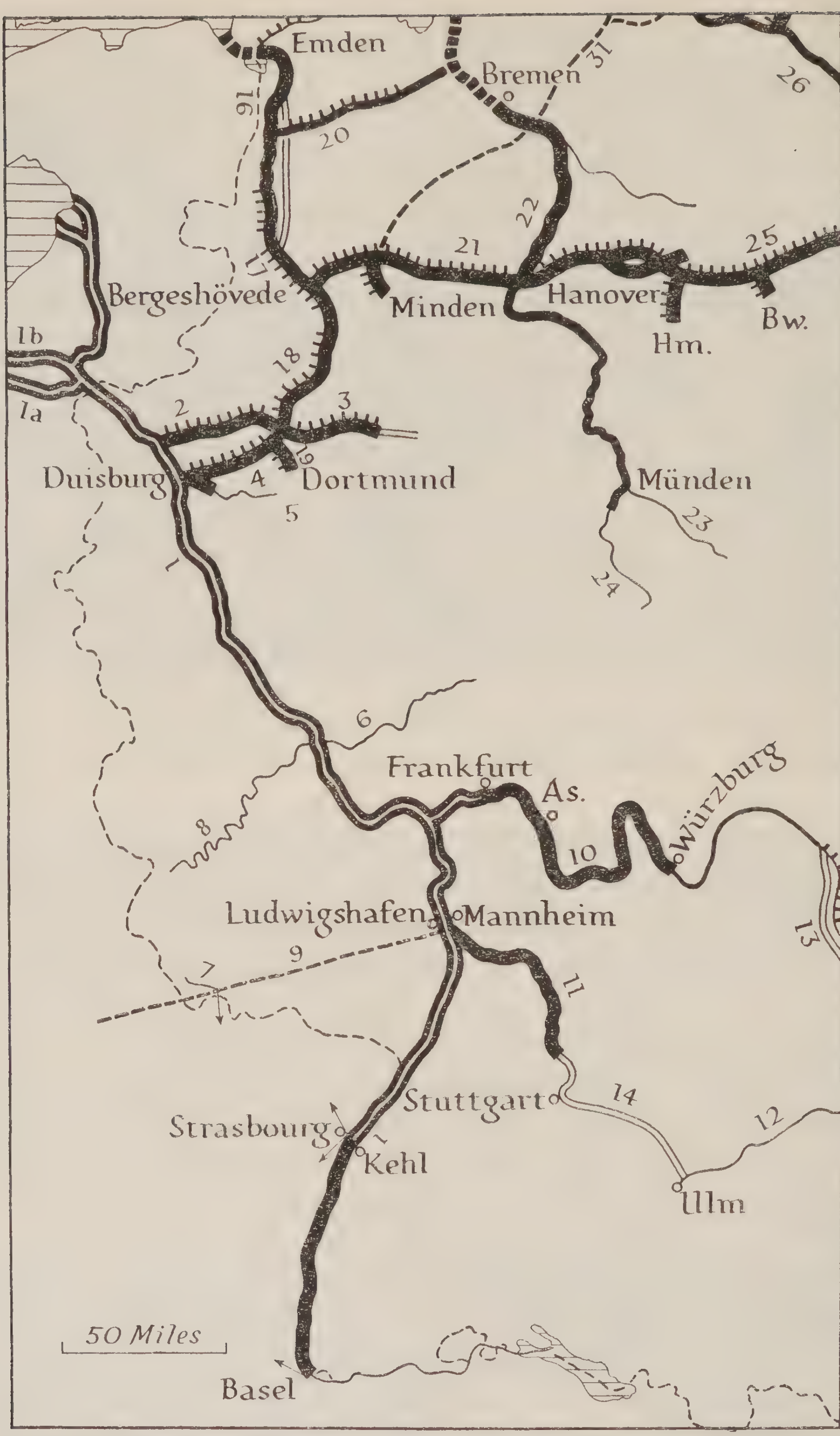

Fig. 128. The waterways of western Germany

Based on official sources.

For key to capacity of waterways, see Fig. 148. Arrows show connecting waterways. As. Aschaffenburg; Bn. Brunswick; Hm. Hildesheim. 1 Rhine; 1a Waal; 1b Neder Rijn; 2 Wesel-Datteln C.; 3 Datteln-Hamm C.; 4 Rhine-Herne C.; 5 Ruhr; 6 Lahn; 7 Saar; 8 Mosel; 9 projected Saar—Palatinate C.; 10 Main; 11 Neckar; 12 Danube; 13 Main—Danube C. (under construction); 14 Neckar—Danube C. (under construction); 16 canalized Ems, Emden—Herbrum; 17 Dortmund-Ems C., Herbrum—Bergeshövede; 18 ditto, Bergeshövede—Datteln; 19 ditto, Datteln—Dortmund; 20 Ems—Jade C.; 21 Ems—Weser C. (W. Mittelland); 22 Weser; 23 Werra; 24 Fulda; 25 Weser—Elbe C. (E. Mittelland); 26 Elbe; 31 projected Hansa C. Note: latest reports show that the Weser (no. 22) can take barges of only 650 tons and the Datteln-Hamm C. (no.3) barges of only 750 tons.

The Waterways of Western Germany

Waterway	Length (miles)	Max. barge capacity (tons)	Tonnage carried, 1937 (thousands)
Rhine	443	3,500–1,200	90,589
Wesel-Datteln C.	38	1,000*	3,001
Datteln-Hamm C.	27	750	2,111
Rhine-Herne C.	32	1,500	19,887
Lahn	42	190	254
Saar	26	290	751

From official sources.

In this summary table, and in those on pp. 575, 582, 605, the tonnage carried on each waterway represents the tonnage which passes over it, and includes both tonnage originating on the waterway and tonnage passing through between other waterways. Some cargo is counted more than once, therefore. An examination of the tonnage 'put on barge' is given on pp. 544–59, where the goods are counted only once. Both sets of figures are relevant to a study of waterways.

The figure of 3,500 represents the normal maximum which can be carried as far as Köln, and 1,200 the normal maximum above Köln. There is a record of a Dutch barge, the *Grotius*, with a capacity of 4,300 tons, being used below Köln.

* Exceptionally 1,500.

The Rhine

With a total length of 807 miles, the Rhine is navigable for 443 miles from Rheinfelden, on the Swiss frontier above Basel, to the Netherlands frontier. From its elbow bend at Basel, the German Rhine falls into three major sections: the Upper Rhine, from Basel to Bingen, where the river follows a regulated course over the flat plain of the Rhine Rift valley; the Middle Rhine, from Bingen to Bonn, where the Rhine has cut its great gorge through the Middle Rhine Highlands; and, below Bonn, the river continues through the Köln 'bay' to cross the Lower Rhine Plain, and enter the Netherlands below Emmerich.

Physical Characteristics. Downstream from the barrage at Kembs, below Basel, there are no locks to hinder navigation through to the North Sea. The modern extensive use of the Rhine as a waterway depends, especially in its upper reaches, on improvements which were carried out in the nineteenth and early twentieth centuries.

The regime of the Rhine contrasts with that of the other major German waterways, chiefly because of its westerly position, and also because its sources lie in the High Alps. Regularity of flow and minimum stoppage to shipping through winter freezing are great advantages. Above the Neckar confluence at Mannheim the Upper

Rhine has an alpine regime: reinforced by melting snows in spring and early summer, it reaches its maximum volume in June, July and August, and its minimum in January and February (Fig. 129). The Swiss piedmont lakes, together with Lake Constance, also serve to regulate the flow of the Rhine. Below the Neckar, and especially below the Main confluence, there comes a great change. The rainfall maximum occurs in summer rather than winter, though the increased supply at that season is offset by increased evaporation. Autumn and winter are the seasons of greatest flow of the Middle and Lower Rhine, a second maximum occurring in summer. Thus, while Mainz has a January and June maximum, when the water levels are about equal, Köln has a triple maximum, in March, June and December (Fig. 129).

Volume of the Rhine in cubic metres per second

	Low water	Average water	High water
Basel	330	865	4,624
Kehl	380	956	4,685
Lauterbourg	465	1,106	5,010
Koblenz	1,120	1,750	10,000
Emmerich	1,430	2,030	11,000

From: Demangeon, A., Febvre, L., *Le Rhin*, p. 155 (Paris, 1935).

In spite of reinforcement of the Rhine downstream by the mass of Alpine water, which equalizes the flow between high and low water, the period of commercial navigation between Basel and Strasbourg is only 90 days a year (June—August), corresponding with the period of summer high water. Even then, in times of exceptional drought, there may be insufficient water. Variation in current strength is another significant factor which affects the navigation of the Rhine. Where the gradient exceeds 1 : 1,000, navigation is not practicable, as with the Rhine above Rheinfelden, along the Swiss frontier. From Basel to Strasbourg the gradient is 0·86 : 1,000, and the strong current in this reach makes upstream navigation difficult. Below Strasbourg (only 472 ft. above sea-level) the strong currents slacken, and the stretch between Mainz and Bingen resembles a lake in its placidity, but the currents increase again in the Rhine gorge, especially in the vicinity of the Lorelei deeps.

Gradients of the German Rhine

Strasbourg to Bingen	0·51 : 1,000–0·1 : 1,000
Bingen to St Goar	0·5 : 1,000
St Goar to Koblenz	0·23 : 1,000
Koblenz to Köln	0·18 : 1,000
Köln to Emmerich	0·13 : 1,000

From: Demangeon, A., Febvre, L., *Le Rhin*, pp. 157–8 (Paris, 1935).

Fig. 129. Seasonal variations in volume of the Rhine
Based on Demangeon, A., Febvre, L., *Le Rhin*, p. 152 (Paris, 1935).

The strength of the Rhine current decreases proportionally to the gradient downstream and is at its maximum at the time of high water (except in the lowest reaches where there is a low-water channel and a much wider high-water channel, the latter often contained by flood dykes). The rate of movement is exemplified thus:

Istein rapids (Kembs)	18 km. per hour
Basel to Strasbourg	8–9 ,, ,, ,,
Strasbourg to Lauterbourg	7–8 ,, ,, ,,
Lauterbourg to Mannheim	6–7 ,, ,, ,,
Mannheim to Bingen	4–5 ,, ,, ,,

From: Demangeon, A., Febvre, L., *Le Rhin*, p. 158 (Paris, 1935).

The Rhine is the least troubled by ice of all the major German rivers. At Mainz there are, on the average, 15 days of ice, but no fast (land) ice. In the exceptional winter of 1929, ice stopped traffic for 35 days and transport between the Ruhr and the Netherlands ceased, British coal arriving at Rotterdam. In 1845 the Rhine froze for 70 days.

The limit for sea-going ships up the Rhine is Köln, up to which point there is a minimum depth of 9 to 10 ft. From Köln to Mannheim, the minimum depth is 9 ft., except in the gorge, where it decreases in places to between 8 and 9 ft. From Mannheim to Strasbourg it averages 6½ ft. and becomes shallower above this stretch. From Rotterdam to Duisburg, the Rhine can accommodate barge trains carrying 6,000–7,000 tons. Between Duisburg and Mannheim, barge trains of 5,000 tons are usual and convoys of 1,000–2,000 tons may proceed as far as Strasbourg. It is, however, rare for a convoy of over 2,000 tons to pass between Mannheim and Strasbourg and for one from 1,200 to 1,500 tons to reach Basel from Strasbourg. In the section between Mainz and the Swiss frontier at Basel, artificial improvements have converted the Upper Rhine into a navigable channel for barge trains. By 1866, the Rhine was improved to Mannheim, and between 1906 and 1916 the channel between Mannheim and Basel was straightened, a work involving cutting through the numerous meander channels of the Rhine (see Fig. 10, vol. i of this Handbook), and the construction of embankments. Increased current velocity resulted. At the Kembs barrage, by the Istein rapids below Basel, locks occur, 328 ft. by 82 ft. and 607 ft. by 82 ft., at the site of the power station. Below this point there are no artificial obstructions to navigation.

Economic Importance. In 1939, the Rhine fleet had a capacity of over 2 million metric tons, and, in 1937, the traffic density was 22·8

million metric ton-km. per km. Over the entire river, traffic is very unequal, two-thirds being concentrated at Duisburg-Ruhrort, at the Rhine-Ruhr confluence, and at nearby river ports serving the Ruhr industrial region. Of the remaining third, three-sevenths is dealt with at Mannheim-Ludwigshafen, three-sevenths by the river ports between Duisburg-Ruhrort and Mannheim-Ludwigshafen, and one-seventh above Mannheim.

Duisburg-Ruhrort is the greatest river port not only of Germany but of the whole of Europe. As the traffic node of the Rhine, it handled 34 million tons of goods in 1937. It had miles of dock accommodation, and quays with excellent wharfage facilities, including special loading and discharging appliances. It specializes in handling coal, coke, iron ore, and petroleum in bulk (Plate 106), to deal with which there are normally about 190 cranes, transporters, coal-tips, etc. The basins of Duisburg, Ruhrort, Hochfeld and Hamborn * extend for a total length of 27 miles and have a water area of 22,240 acres. The chief basins are shown in Fig. 130. The engineering firm of *Demag A.G.* is widely known for its work as a constructor of cranes and all other forms of hoisting gear, an activity reflecting both the trade of the port and the industries of the neighbourhood. The company has supplied cranes, often of highly specialized types, to many seaports outside Germany. It has probably constructed more cranes (of all types) than any other similar concern; it is the leading constructor of floating cranes, and claims to have built over half of all the floating cranes in the world.

Other river ports which serve the Rhine—Ruhr industrial region are Krefeld-Uerdingen, with steel, chemical and textile industries, and Düsseldorf-Neuss, the port for the Wuppertal steel, engineering, textile and chemical manufacturing region, which handled 3·9 million tons in 1937. Some of the smaller river ports, e.g. Walsum, Hamborn, Homberg and the Rheinhausen have private wharves and are

* The administrative area of Duisburg-Hamborn, with a population of 431,000 in 1939, now includes the two original port settlements (Duisburg on the south bank and Ruhrort on the north bank) of the Ruhr, at the Rhine confluence, together with Hamborn, the industrial town to the north of the Ruhr river. Both in common usage and in the waterway traffic returns, however, the port is referred to as 'Duisburg' or 'Duisburg-Ruhrort'. The traffic returns distinguish five constituent parts of the waterway port: Duisburg-Ruhrort (*Hafen A.G.*), Duisburg-Huckingen, Duisburg-Schwelgern, Duisburg-Rheinufer, and Duisburg-Meiderich. Of all the traffic handled by these five, about two-thirds is accounted for by the Duisburg-Ruhrort division. There are twelve railway stations under the name 'Duisburg': Duisburg-Beeck, -Buchholz, -Hamborn, -Hochfeld Süd, -Huckingen, -Hüttenheim, -Meiderich Süd, -Obermeiderich, -Ruhrort, -Stadion, -Wanheim, -Wanheimerort.

owned by coal companies and steel works. Wesseling, the port for the lignite coalfield between Bonn and Köln, handling 3 million tons in 1937, specializes in the shipment of lignite, especially for the Köln power stations. Köln, at the limit of navigation for small sea-going craft, dealt with 3·4 million tons of traffic in 1937. This city is an industrial centre with port industries, such as oil-refining, sugar-refining, rubber manufacture, etc., and it is a transhipment centre for Aachen coal. Deutz, on the right bank, is also an industrial area.

Upstream, apart from the small ports of the Rhine gorge (Bonn, Koblenz, Oberlahnstein), one of the most important centres is Mainz, opposite the Main confluence, where the Rhine changes its direction at the northern end of the Rift Valley. This port handled 2·5 million tons in 1937. The twin ports of Mannheim-Ludwigshafen at the Neckar-Rhine confluence, had a turnover of 11 million tons in 1937. These twin ports specialize in handling coal, iron and steel, chemicals and petroleum, and they are well equipped with transit handling gear and have ample storage space. There are 30 miles of water frontage (Fig. 131), normally equipped with about 190 cranes, transporters and other hoisting gear. The major industries here are heavy chemicals (*I.G. Farben-Industrie*), metallurgy and engineering, and there are also oil refineries, flour and paper mills. Karlsruhe, with 3 million tons of traffic in 1937, has special port facilities for handling grain, mineral oil, coal and coal briquettes. Above Karlsruhe up to Kembs, there is much less traffic and a corresponding absence of industry on the banks of the Rhine. However, the Upper Rhine Plain, on account of its varied and rich agricultural resources, is a generally densely populated region. Potash (*Kali*) salts, found in Baden as well as Alsace, together with timber from the Black Forest, are shipped down the Rhine, while a certain amount of coal, grain, and petroleum, etc., moves upstream to Strasbourg and Basel.

In normal times, the Rhine carries two-thirds of the total waterway traffic of Germany and four-fifths of the foreign trade moving by waterway. Of the enormous bulk of traffic moved, coal, iron ore, cereals and timber have pride of place. In 1937, 25·7 million tons of traffic moved upstream at the Dutch frontier, comprising 13 million tons of iron ore, 2·8 million tons of grain, etc., as well as timber, oil-seeds and oil-cake, beet sugar and petroleum, etc. Downstream, 33 million tons of goods passed the frontier, including 23·7 million tons of coal, coke and lignite briquettes, 2 million tons of iron and steel, 1·5 million tons of fertilizers, as well as chemicals, cement, paper, etc.

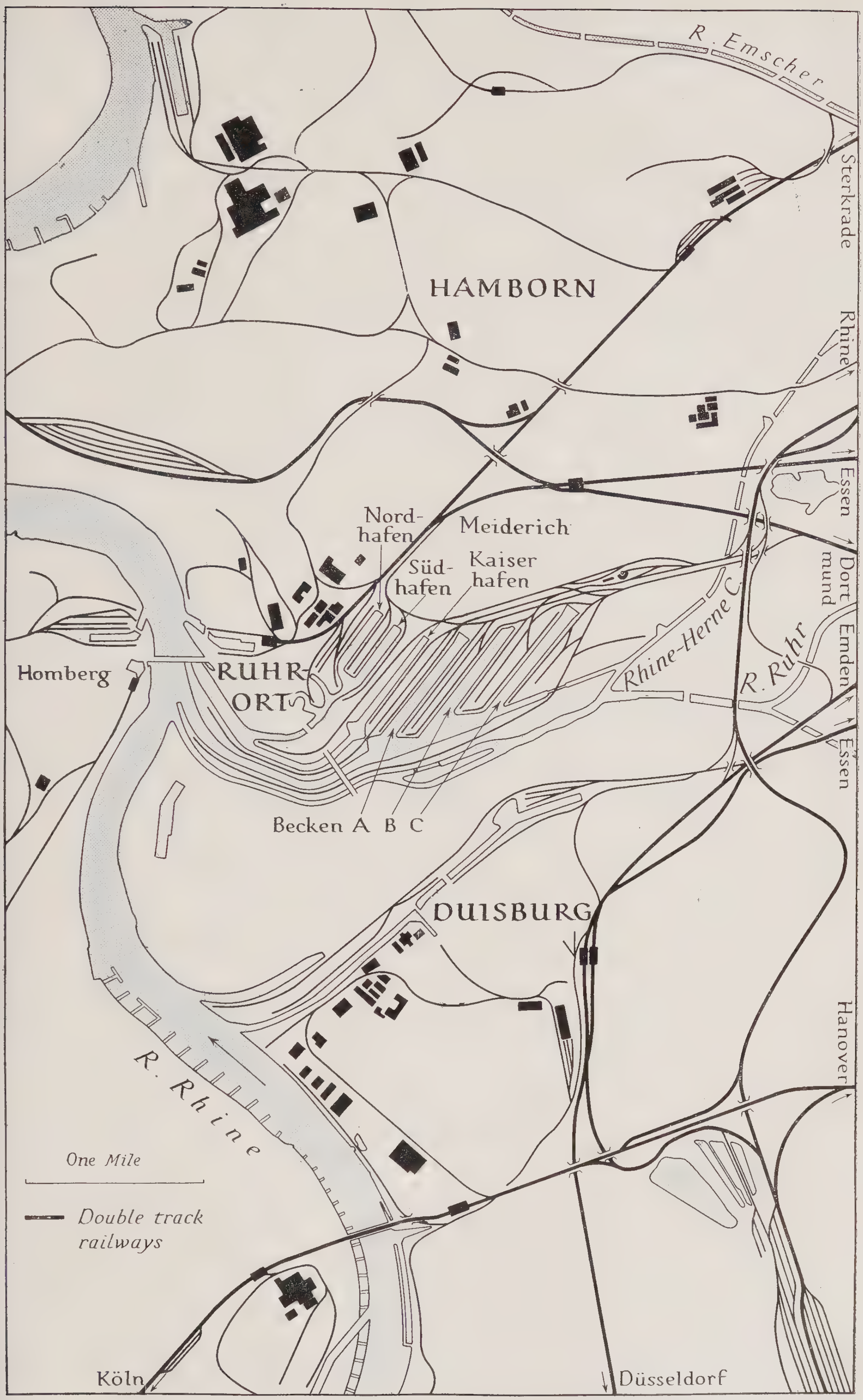

Fig. 130. Duisburg-Ruhrort (Duisburg-Hamborn)

Based on G.S.G.S. Series 4480, Duisburg-Hamborn.

The six parallel basins provide the principal facilities of this inland port, the largest in Europe. The railway bridge shown is the Duisburg-Hochfeld bridge; the Duisburg-Ruhrort bridge is north-west of Homberg. The road bridge is the *Admiral Scheer* bridge.

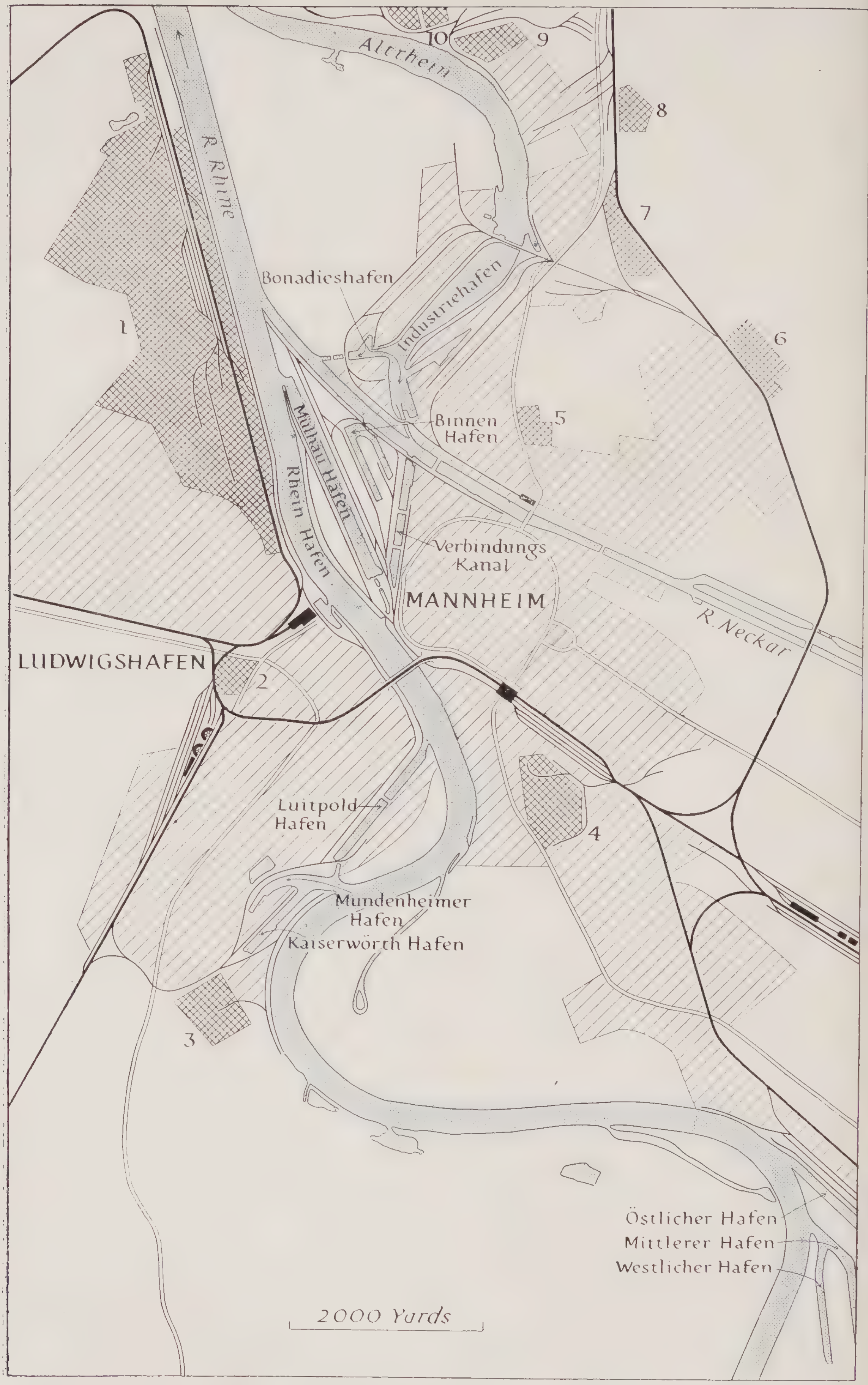

Fig. 131. Mannheim-Ludwigshafen

Based on G.S.G.S. Series 4480, Mannheim-Ludwigshafen (two sheets).

1 *I. G. Farbenindustrie*; 2 railway workshops; 3 *Giulini* (alumina); 4 *Lenz* (tractors); 5 *Motorenweke Mannheim* (diesels); 6 *Brown Boveri* (turbines, etc.); 7 *Daimler Benz* (diesels); 8 *Bopp & Reuther* (meters); 9 paper mill; 10 jute mill, paper mill. See also Fig. 81, Plate 100.

Coal is the leading commodity, comprising two-thirds to three-quarters of the total shipment from German inland ports, and it moves mainly from Duisburg-Ruhrort downstream to the Nether-

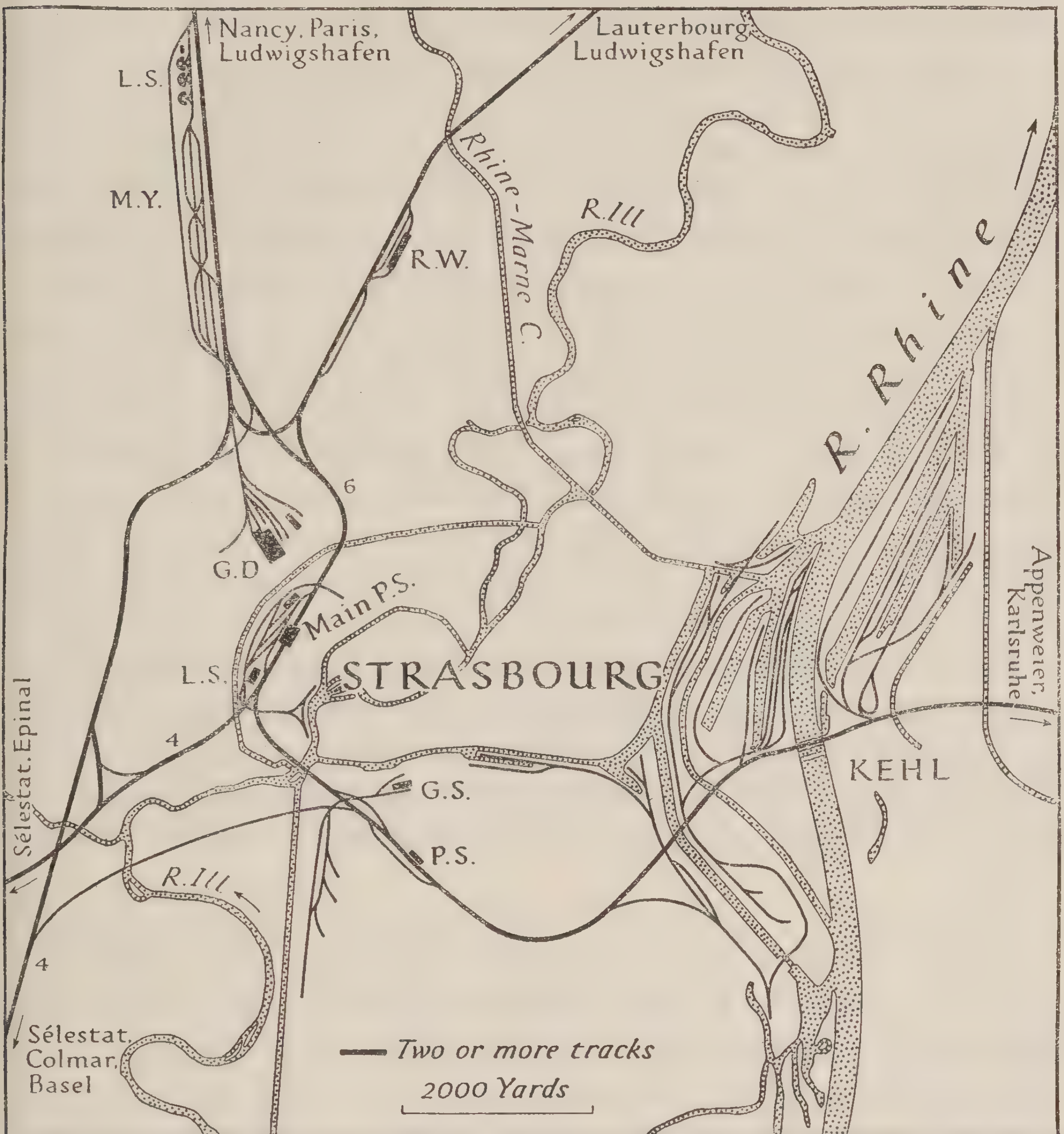

Fig. 132. Kehl and Strasbourg

Based on G.S.G.S. Series 4414, Germany, 1 : 25,000, Sheet 7412, and other official sources.

These two river ports, the one German and the other French, dominate the waterway traffic of the upper Rhineland. In 1936 Strasbourg handled 7·4 million tons of inward and outward traffic (5·1 million tons by the Rhine, and 2·3 million tons by the Rhône—Rhine and Marne—Rhine Canals), while Kehl handled 1·8 million tons (2·1 million tons in 1937). The immediate hinterland of Strasbourg is more important than that of Kehl, and the German port also has to face the competition of Mannheim lower downstream. The two ports stand also at a very important railway crossing. G.D. Goods depot; G.S. Goods station; L.S. Loco. shed; M.Y. Marshalling yard; R.W. Railway workshops. The figures indicate the number of tracks where there are more than two.

lands, and, to a much smaller extent, upstream to Alsace and Switzerland, part of this traffic being sent on by rail to northern Italy. The growing shipment of lignite briquettes from Wesseling must also be taken into account in view of the development of electrical power for industry, etc., generated in the power stations of Köln. Iron ore proceeding upstream from the Dutch ports moves mainly to Duisburg-Ruhrort and Höchst for the Ruhr heavy industries, with smaller quantities for Mannheim-Ludwigshafen (*I. G. Farben*). Baltic and Canadian timber, especially pit-props for the Ruhr, move upstream from the Dutch ports, and, similarly, grain imported from America, destined for southern Germany and Switzerland, together with petroleum. Building materials, stone, sand and cement move downstream to the Ruhr and the Netherlands. Iron ore from Lorraine, potash salts from the Upper Rhine Plain move via Strasbourg to the ports for the Ruhr, etc. Timber from the Black Forest and Odenwald is dispatched from Karlsruhe and Mannheim, and there is a small movement of iron ore from Oberlahnstein at the mouth of the Lahn, and also building stone, road metal, cement, etc., from the Rhine gorge ports from Bingen to Bonn.

The barges operating in the section of the Rhine serving the Ruhr are partly controlled by the dimensions of the Rhine-Herne C. and so their capacity generally varies from 1,300 to 1,500 tons. In general, however, 85% of the Rhine fleet consists of barges varying between 750 and 1,750 tons; of these 44% range between 1,250 and 1,750 tons.

The Rhine is made additionally important to the economic geography of Germany on account of its connexions with other systems. Moreover, it has an international rôle to play as a traffic waterway between the Netherlands and Belgium, Germany, Switzerland and France by way of Strasbourg and indirectly Italy, by means of transhipment from barge to rail at Strasbourg and thence to Basel. It is connected with the French waterway systems of the Rhône, via the Rhône-Rhine canal, and the Marne, via the Rhine-Marne canal, both of which enter the Rhine at Strasbourg.

It should be remembered that the Rhine plays an important part in the traffic movement of a wide area in eastern France. For example, the region between Dijon and Lyons is a zone in which English coal entering via Marseilles competes with German coal entering via Strasbourg (see p. 269 of the N.I.D. Handbook on France, vol. iii).

In the north, the Ruhr-Westphalian canals connect the Rhine with

the waterways of the North German Plain, notably via the Rhine-Herne, Wesel-Datteln and Datteln-Hamm canals (see p. 573). These connect with the Dortmund-Ems system at Datteln. The Ruhr is also canalized a short distance to Mülheim. When the Mittelland C. was completed in 1938, the first project in the unification of the German inland waterway system materialized through the interconnexion of the Rhine, Weser, Elbe and Oder.

The second project of major importance, which will in time unify water transport between north-west and south Germany and which will eventually affect traffic on the Middle and Lower Rhine, is the scheme to connect the Main and also the Neckar with the Danube (see p. 579). At present, traffic on these Rhine tributaries is entirely to and from the Rhine, and is chiefly handled by Mainz and Frankfurt (Main waterway) and by Mannheim (Neckar system). The construction of canals linking the Main with the Danube at Kelheim and the Neckar with the Danube at Ulm will provide through waterways between the Rhine and the Danube, linking the North Sea with the Black Sea by an inland system across central Europe, avoiding the Mediterranean. Such a waterway would be of some strategic as well as economic importance, and it would greatly cheapen the movement of surplus agricultural produce, timber, minerals, etc., from the lower Danubian lands to industrial north-west Europe. Conversely, such an international waterway would stimulate the sale of manufactured goods in a part of Europe which has remained backward and undeveloped industrially.

The Saar

Of the rivers draining the Middle Rhine Highlands, only the Mosel, its tributary the Saar, and the Lahn are generally navigable for vessels up to 300 tons, and for commercial purposes these rivers are of limited value, unlike the Main and the Neckar.

Crossing the German frontier from France in the neighbourhood of the Saar coalfield, the Saar river winds through a deep-cut valley, along the western edge of the Hunsrück plateau. It leaves its gorge section to join the Mosel just above the city of Trier. Owing to the economic importance of the Saar coalfield, the river has been improved so that it carries more traffic than the Mosel or Lahn. It has a navigable length inside Germany of 26 miles, and can accommodate craft of 290 tons. Most of the traffic is local, derived from the Saar coalfield and consists of coal and coke, together with iron ore from the Lorraine-Luxembourg ironfield, cement, chemicals, etc.

The Mosel

This long left-bank tributary of the Rhine, which it enters at Koblenz, suffers from serious drawbacks as a commercial waterway. Below Trier and the Saar confluence, the Mosel flows through a deep gorge between the Eifel and Hunsrück mountains and the stream meanders in a series of great loops across the floor of the valley. Unlike most other major German waterways, the Mosel has not been straightened and improved for navigation.

The handicaps from which the Mosel suffers are partly the result of the 'bottle neck' character of the valley, but they are also inherent in the character of the river. The current is swift and strong, so that upstream traffic is almost impossible, and also the devious nature of the stream means that much loss of time is involved in navigating such a tortuous river. Owing to the proximity of the river to the French and Luxembourg frontiers, the river has not been improved. Apart from strategic reasons, political and economic considerations have led to the neglect of the Mosel. It was not in the interest of the Ruhr industrialists to cheapen the shipment costs of coal and coke in the direction of Lorraine after the annexation of part of this province in 1871. As a result, iron ore from this field moves by rail to the Ruhr or by rail and water, if routed via Strasbourg. Similarly, most Saar coal is rail-borne.

The Lahn

In contrast with the Mosel, the Lahn has been canalized from its confluence with the Rhine at Oberlahnstein to a point a few miles above Wetzlar. The river, like the Mosel, flows through a narrow valley, between the Westerwald and Taunus highlands, and meanders widely. In view of the sparse population of the Middle Rhine Highlands and the general absence of industry, the river carries very little traffic, except for some iron ore, limestone and cement. It has a navigation channel of 42 miles, but it can only accommodate barges up to 190 tons.

The Wesel-Datteln Canal

The rivers which drain the Ruhr coalfield, the Ruhr and the Lippe, are not navigable, except for a short stretch of the Ruhr which has been canalized up to Mülheim, but a series of canals serves to connect the lower Rhine with the coalfield, and by means of the Dortmund-Ems C. (see p. 584), to connect the industrial area with the North

Sea ports of Emden and Bremen, and with the Elbe and Berlin by way of the Mittelland C. (see p. 590). These canals are the Wesel-Datteln C., the Datteln-Hamm C. and the Rhine-Herne C. (the first two are known in Germany as the Lippe C.). These canals also permit internal or local traffic movements; on the Wesel-Datteln C. and Datteln-Hamm C., this amounted to 500,000 tons in 1937. The Emscher and Lippe rivers, tributaries of the Rhine, are not classed as navigable waterways.

Completed in 1930, the Wesel-Datteln C. extends from Wesel, a river port on the Rhine, to Datteln on the Lippe. It is 38 miles long and has six locks, with a total lift of 127 ft. The canal can accommodate barges up to 1,000 tons. Most of the traffic consists of coal and coke, petroleum, and the products of heavy industry from the Lippe valley in which the canal lies. At Datteln the canal joins the Rhine-Herne C. at the point where it connects with the Dortmund-Ems C. Entrance to this canal is gained through the Emscher lock.

The Datteln-Hamm Canal

Crossing the junction of the Rhine-Herne and Dortmund-Ems canals at Datteln, the Datteln-Hamm C. forms an extension of the Wesel-Datteln C. along the Lippe valley for 27 miles as far as Hamm. It is proposed to extend the canal eventually as far as Lippstadt. This projected section is to be known as the *Hamm-Lippstadt C.* There are three locks on the present canal, including one at Hamm, and another is planned for the new stretch. The Datteln-Hamm C. can take barges up to 750 tons and so is an integral part of the Ruhr-Westphalian waterway system. The canal is fed from the river Lippe, and acts as the feeder of all the west German canals. Most of the traffic consists of coal, coke, iron ore, petroleum and the products of heavy industry.

The Rhine-Herne Canal

Opened in 1914, the Rhine-Herne C. forms in effect a western extension of the Dortmund-Ems C. beyond Datteln. With a length of 31 miles, the canal stretches from the group of river ports of Duisburg-Ruhrort at the Rhine-Ruhr confluence, to Herne, north of the Ruhr valley. There are seven locks along the canal, providing a total lift of 118 ft. Owing to the extensive coal-mining operations in the neighbourhood, subsidence has caused several of the locks to settle. A ship-lift at Henrichenburg enables craft to enter the southern branch of the canal leading to Dortmund (Dortmund-Ems

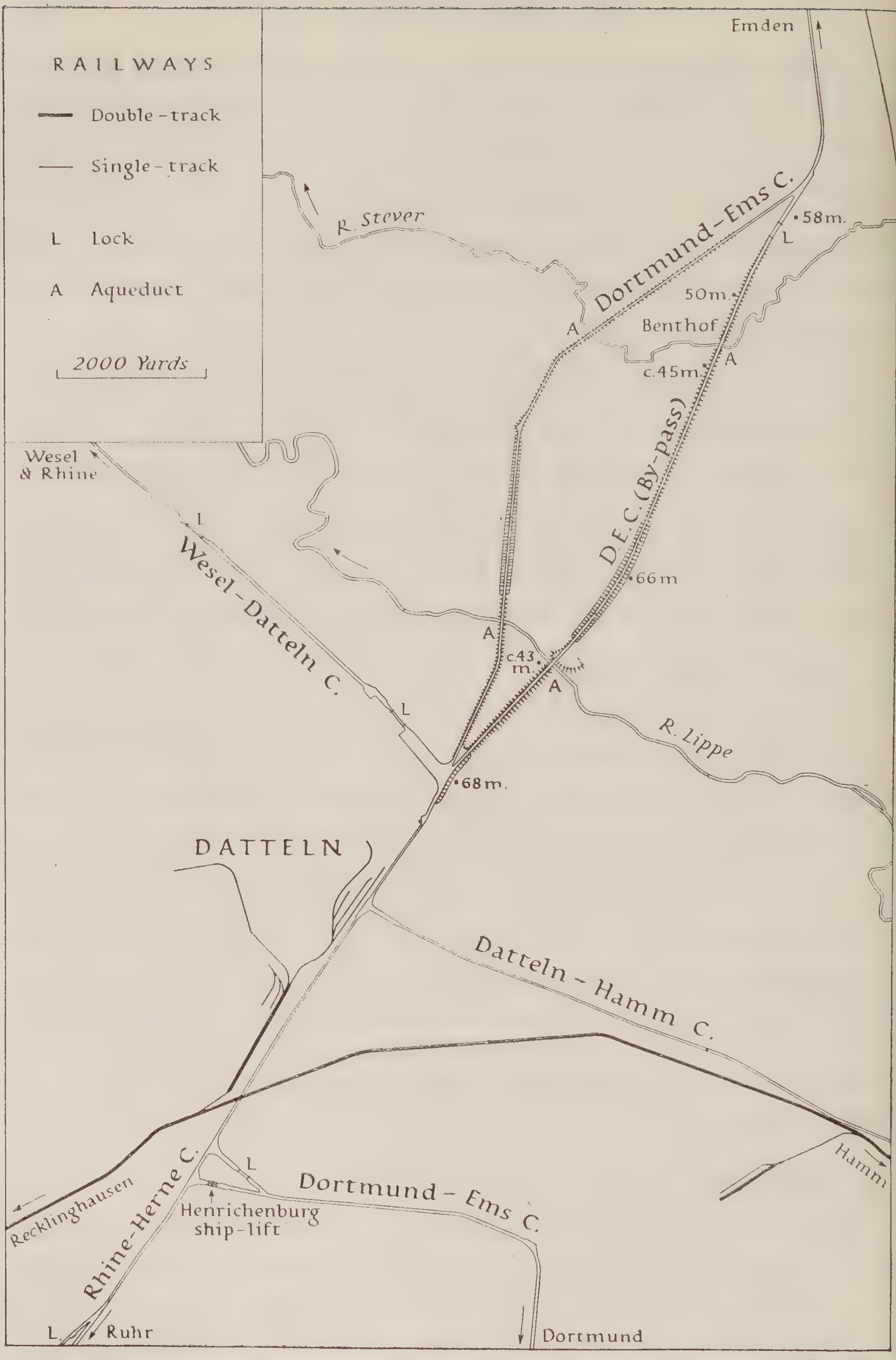

Fig. 133. The canal junctions of Datteln

Based on G.S.G.S. Series 4414, Germany, 1 : 25,000, Sheets 4209, 4210, 4309, 4310, 4409, 4410.

Through these three junctions pass several streams of traffic: (*a*) Rhine and western Ruhr to Dortmund via the Rhine-Herne and upper Dortmund-Ems canals; (*b*) Rhine and Ruhr to Emden; (*c*) Rhine and Ruhr to Hanover and Berlin via the Dortmund-Ems and Mittelland canals; (*d*) eastern Ruhr to Dutch frontier via Wesel-Datteln C. Details of the Dortmund-Ems C. are shown in Fig. 137 and of the Benthof aqueduct in Fig. 138. Certain altitudes are shown in metres.

terminal). The Rhine-Herne C., which lies parallel to the Ruhr, can take vessels of 1,500 tons. The great river port of Duisburg-Ruhrort (Fig. 130) handles the greatest amount of traffic of all the Rhineland river ports (37 million tons in 1929 and 34 million tons in 1937). Much of this traffic proceeds via the Rhine-Herne C. to and from the terminal ports. The great bulk of the coal export from Duisburg-Ruhrort, however, arrives at the basins by rail.

The Waterways of South Germany

East of the Rhine and its right-bank tributaries, the Main and the Neckar, water transport is of minor importance in south Germany, compared with the west and north. The Danube, rising on the eastern slopes of the Black Forest, flows eastwards across a comparatively thinly populated region towards the Austrian border. Its importance as a commercial waterway begins at Kelheim, 93 miles from the Austrian frontier at Passau. Its long Alpine tributaries are useless for navigation. The present importance of the Main and Neckar is mainly as tributaries of the Rhine traffic circulation, but in view of the potential importance of canal connexions between the Rhine and Danube via the Main, and also the Neckar, these waterways are dealt with in this section as part of south Germany.

The Waterways of South Germany

Waterway	Length (miles)	Max. barge capacity (tons)	Tonnage carried, 1937 (thousands)
Main, from Rhine to Frankfurt	—	3,000	—
from Frankfurt to Würzburg	—	1,200	—
from Rhine to Aschaffenburg	54·0	1,500	5,111
from Aschaffenburg to Bamberg	193·2	—	927
Neckar, from Mannheim to Heilbronn	—	1,200	—
from Mannheim to Lauffen	79·5	1,200	1,675
Danube, from Kelheim to the Austrian frontier at Passau	132·2	1,000	1,481

From official sources.

The Danube

For two-thirds of its length in south Germany the Danube is at present almost useless economically. The headstreams of the Danube, rising on the eastern slope of the Black Forest, converge at Donaueschingen, and the river then flows north-eastwards past Tuttlingen

Fig. 134. The waterways of south Germany

Based on official sources.

For key to capacity of waterways, see Fig. 148. Arrows show connecting waterways. As. Aschaffenburg; F Frankfurt-am-Main; Mn. Mannheim; S Stuttgart; Wz. Würzburg. 1 Rhine; 10 Main; 11 Neckar; 12 Danube; 13 Main—Danube C. (under construction); 14 Neckar—Danube C. (under construction); 15 Ludwigs C.; 26 Elbe.

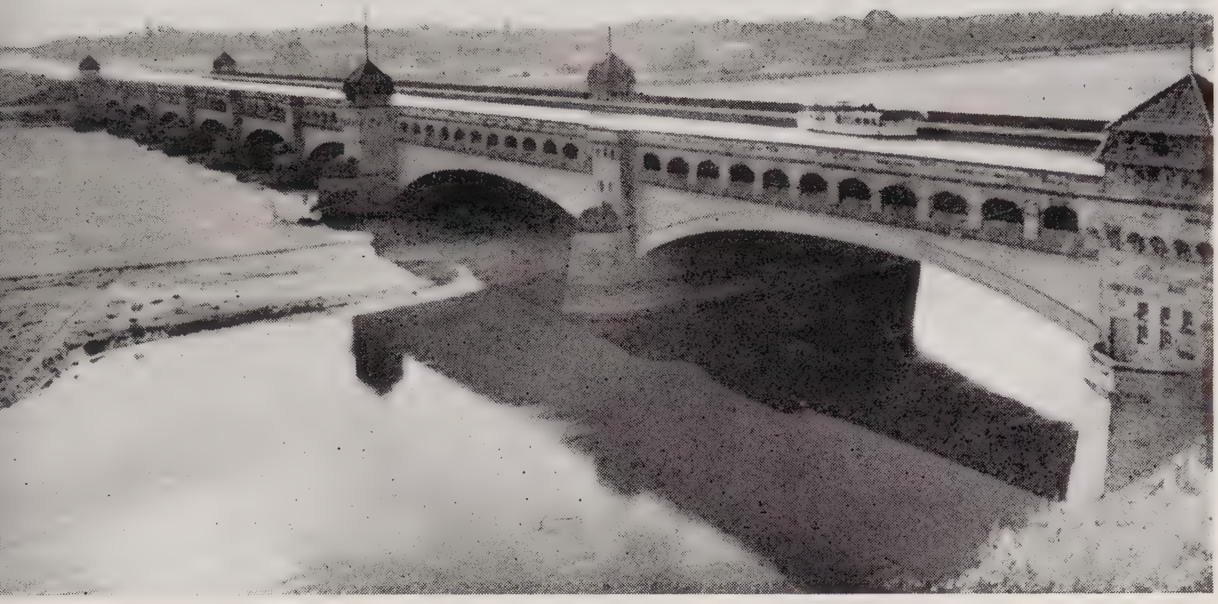

Plate 115. Mittelland Canal: Weser aqueduct, Minden

This aqueduct over the Weser effects the junction of the Ems-Weser and Weser-Ems canals (Fig. 139).

Plate 116. Weser-Elbe (Mittelland) Canal: lock at Sülfeld

This lock allows the descent of the canal at the western end, towards Magdeburg, of the elevated central position. It is constructed with a view to saving water during locking; to lower, or raise, barges water is pumped from the lock chamber into the tanks on either side, or from the tanks into the chamber, respectively. The pump house can be seen on the right.

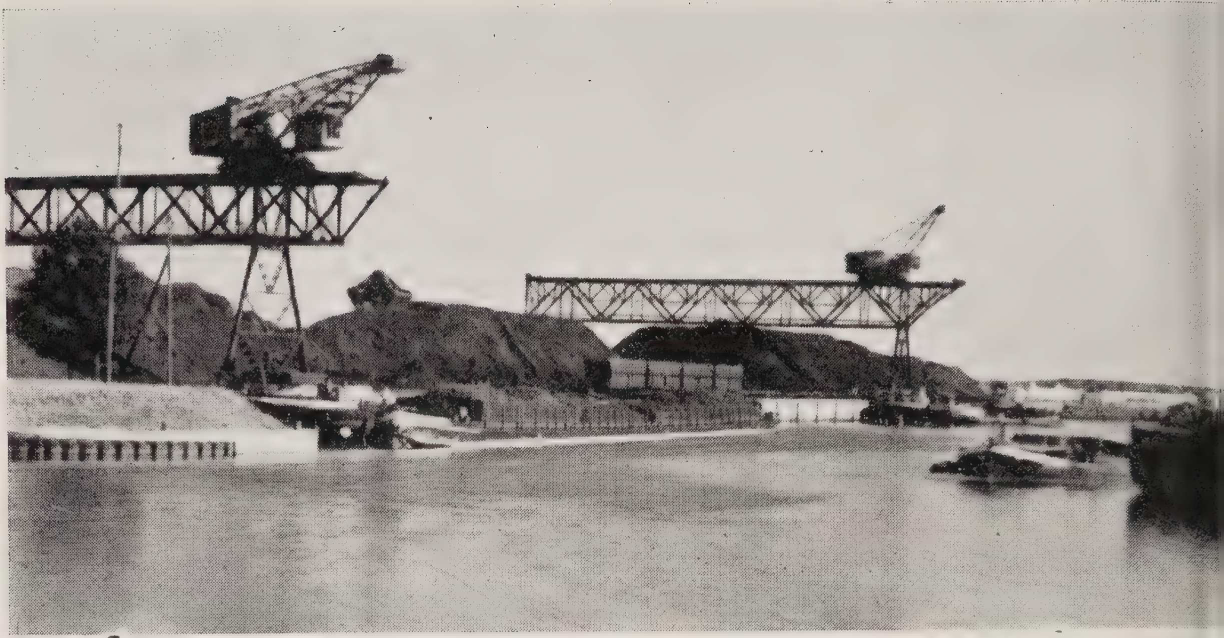

Plate 117. Weser-Elbe (Mittelland) Canal: Ilseder Hütte Harbour, Peine

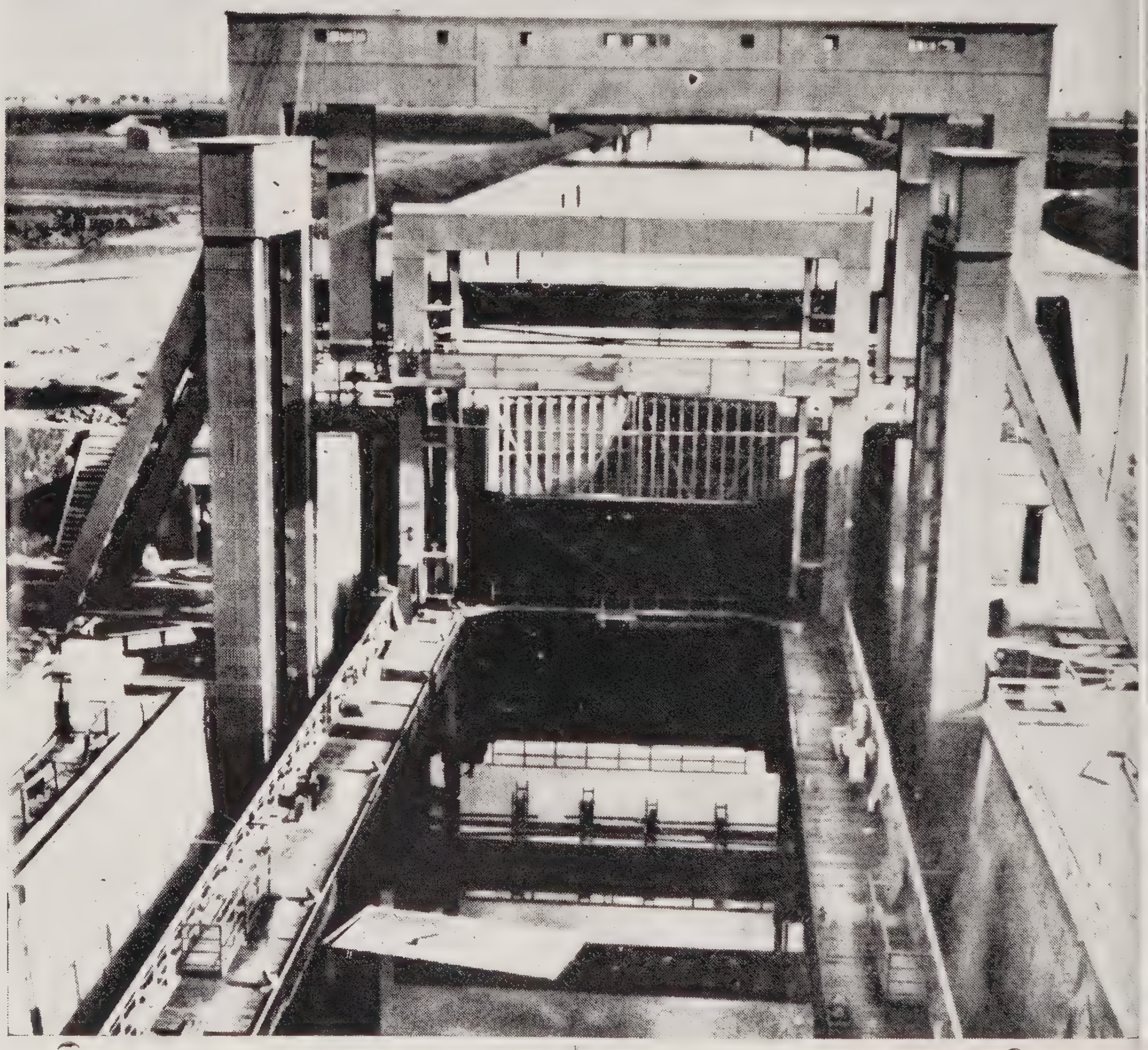

Plate 118. Weser-Elbe (Mittelland) Canal: Rothensee ship-lift
The location of this ship-lift is indicated in Fig. 143; it is shown here at an advanced stage during its construction. Operation began in 1938.

and Sigmaringen, cutting a deep gorge through the limestone country of the Swabian Jura. The river suffers from low water during the late autumn and early winter in this section, and much water is lost by percolation through the limestone, some of the seepage working its way underground to the Upper Rhine. In spring, floods occur owing to snow melt in the Bavarian Alps and the Black Forest. The Danube continues to flow along the southern edge of the Swabian and Franconian Jura to Regensburg (Ratisbon), where it turns south-eastwards, skirting the south-western edge of the Bohemian massif. Between Vilshofen and the Austrian frontier at Passau, the Danube presents severe difficulty to navigation, owing to the swiftness of the current, and the occurrence of rapids where the river-bed lies on the resistant rocks of the Bavarian Forest. A barrage has been constructed at Passau to regulate the depth of water in the Danube in this stretch. The upper Danube basin experiences rather extreme winters and the river suffers from freezing. Ice occurs on the average on 55 days in the year (at Passau) and fast ice on 38 days, but intermittent movement of traffic is usually possible within the period.

The Danube traverses a region of rather sparse settlement, producing little bulk cargo except timber, stone and cement, for conveyance by water. Much of Upper Bavaria is concerned with subsistence farming and there is little development of industry. Moreover, the alignment of the Upper Danube is not such as to attract much waterborne traffic. However, especially for political and strategic reasons, much attention had recently been given to projects for improving the Danube below Kelheim and for connecting it with the Main system by means of the Rhine—Main—Danube canal, and also with the Neckar, via Ulm and Stuttgart. There are also long-range projects to link the Danube, near Bratislava (Pressburg), with the Oder, near Kosel (see p. 613) as an eastern alternative to the western scheme to connect the Danube with the waterway system of the industrial regions of north Germany. In this connexion surplus agricultural produce from the lower Danubian lands and the Balkans, minerals, including iron ore, chrome ore, bauxite, and petroleum are commodities which could be exchanged for the products of manufacturing industry from north and western Germany. It is planned to improve the Danube above Kelheim so that it will eventually be navigable for 1,200-ton barges to Ulm, where the Neckar canal will take off. At present, improvement has mainly taken place between Kelheim and Regensburg, a distance of 21 miles, pending the completion of the Rhine—Main—Danube canal. This section of the

river can now accommodate barges up to 1,000 tons, as with the Rhine—Main—Danube canal now under construction. The river port of Kelheim is likely to assume increasing importance when through traffic from the Rhine to the Danube becomes a possibility. At present, the only connexion with the Main is the century-old Ludwigs C., useless for modern traffic. Ulm is the commercial limit of navigation, but in fact very little traffic passes above Kelheim.

The Main

The longest right-bank tributary of the Rhine pursues a devious course westwards from its sources in the Fichel Gebirge, on the Czechoslovak border. The river cuts through the northern end of the Franconian Jura and then continues westwards past Bamberg, which lies at the limit of navigation for all but the smallest craft (under 200 tons). It describes a series of great loops in the form of a broad 'W', past Schweinfurt and Würzburg to Aschaffenburg. Below this point, the Main cuts a deep defile between the Spessart and Odenwald highlands. Finally, the river enters the northern end of the Upper Rhine Plain (Rift Valley) and here the city of Frankfurt-am-Main lies on the northern bank of the Main. The river crosses the Lower Main Plain to enter the Rhine opposite Mainz.

In spite of the devious course of the Main, it has long served as an important adjunct to the Rhine navigation. The river has been regulated for 155 miles up to Würzburg and provides navigation for craft of 1,200 tons, and beyond 193 miles of navigation for craft up to 200 tons as far as Bamberg. None of the tributaries is navigable. During the winter, the Main experiences ice on 22 days, and fast ice on 2 days, but otherwise its regime is favourable to barge navigation. Recent improvement has necessitated the building of locks below Würzburg; above this point the small amount of traffic has not yet justified their construction.

The Main provides a routeway into the rather sparsely populated country of Lower Bavaria. Apart from the Main Valley, much of the country drained by the river consists of forested uplands, and there is little, except timber, to provide river freight. The most important is the area lying between Frankfurt and Aschaffenburg, the amount of freight carried being nine times that on the higher reaches of the river between Aschaffenburg and Würzburg. The Main has been regulated so as to take craft of 1,500 tons up to Aschaffenburg and 1,200 tons up to Würzburg. This work of canalization has involved the construction of thirteen locks and associated power stations.

These locks are generally 984 ft. long, 39 ft. wide and 8 ft. deep, but some are larger. Above Würzburg an 18-miles long lateral canal connects the Main with Eltmann, a few miles below Bamberg. Above this town, where the old Ludwigs C. takes off southward, and where the Main—Danube canal is to begin, navigation deteriorates and the Main can only take vessels up to 200 tons.

The future importance of the Main is that of a vital link in the Rhine—Main—Danube project. In this connexion, the Main will provide the central section of a waterway, devised to take 1,200-ton vessels, from the North Sea via the Lower Rhine to the Black Sea via the Danube below Kelheim. Work is in progress on the section of the Main between Würzburg and Bamberg, and improvements up to Würzburg were completed by 1938.

The Main—Danube Canal

The concept of a through waterway from the North Sea ports to the Black Sea is no new one. Between 1836 and 1846, the Ludwigs C. was built from Bamberg on the Main, along the Regnitz valley past Nuremberg to the Danube at Kelheim. This shallow and antiquated canal is to-day useless economically. It has no less than 99 locks and can accommodate vessels of only 120 tons. In 1922, when a company was formed to construct the Rhine—Main—Danube canal, to take craft up to 1,200 tons, it was decided to build a new canal, almost parallel to the Ludwigs C. and in places utilizing it.

Between 1919 and 1939, the new canal made slow progress, although for strategic reasons, and especially after the *Anschluss* with Austria in 1938, work was subsequently speeded up. The canal crosses the Regnitz just below Bamberg and then continues southward past Forchheim and Erlangen to Fürth. Nuremberg lies to the east, off the canal. By 1938, a canal dock had been built at Gerbersdorf, near Nuremberg, and another at Maibach is said to be under construction. South of Nuremberg, the canal deviates from the Ludwigs C. and reaches the divide between the Main and Danube drainage at Hilpoltstein, at 971 ft. The ascent to this high level has been one of the main engineering difficulties and necessitates a series of locks (Fig. 135). Beyond this point, the canal enters the Altmühl valley and, beyond Dietfurt, the Altmühl will be canalized to form the last section of the waterway to Kelheim. Here a river port was being developed on the Danube.

Apart from the possible strategic significance of the Rhine—Main—Danube canal, its main future importance lies in the effectiveness

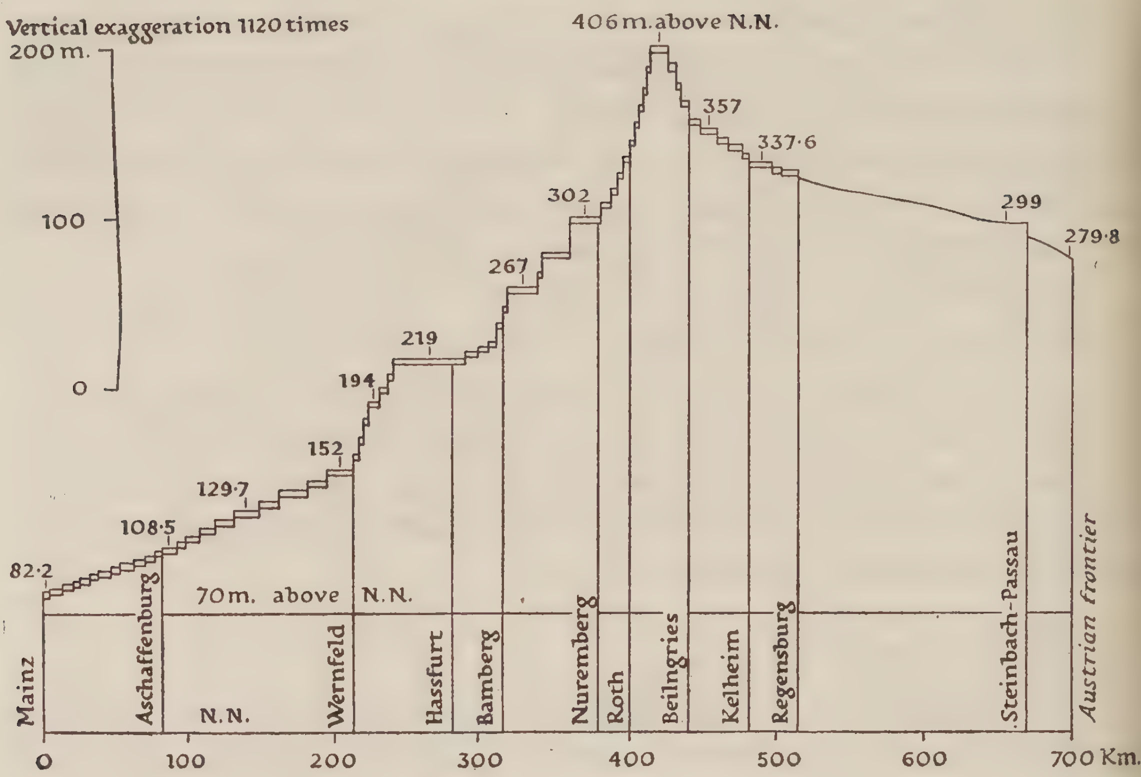

Fig. 135. Profile of the Main—Danube Canal

Based on Franzius, O., *Waterway Engineering*, trans. Straub, L. G., p. 496 (Cambridge, Mass., 1936).

N.N. *Normal null* (the German sea-level datum). The summit lies at Hilpoltstein. Below Bamberg on the Main the waterway comprises the river itself; from Bamberg to Kelheim on the Danube is the canal section proper.

with which it will link the Ruhr-Westphalian industrial region and the lower Rhineland with the Danubian basin. The Danube may develop considerably as a major European waterway. The fact that the waterway will provide a means of transport between the Black Sea and the North Sea across central Europe, thus avoiding the Mediterranean, has been held by some to be a strategic consideration of some importance.

The Neckar

Rising a few miles north of the Danube, in the Black Forest, the Neckar flows northwards across the diversified country of Württemberg, past Plochingen, Stuttgart and Heilbronn, as a highly meandering stream. Below Neckarelz, the river enters a deep gorge, cut across the southern end of the Odenwald. Heidelberg lies at the point where the Neckar leaves these forested highlands for the Upper Rhine Plain. A short course across the monotonously flat country of the Rift Valley floor brings the Neckar to the Rhine at the great

river port and industrial centre of Mannheim. The Neckar has a rather variable regime, with two periods of low water: December—February and September—October. The winter minimum is due to freezing in the upper reaches and the autumn minimum occurs between the peak period due to snow melt and the onset of autumn rains.

In order that the Neckar could function as a commercial waterway, extensive improvements have had to be carried out. A large number of meanders have been cut through in order to straighten the channel, and long stretches of the Neckar have been canalized. In order to provide 75 miles of navigable waterway for barges of 1,200 tons, no less than fifteen locks have been constructed between Mannheim and Lauffen, a few miles above Heilbronn, the former limit of navigation. These locks have uniform dimensions of 360 ft. length, 39 ft. width and 10 ft. depth, and each lock is associated with a hydro-electric power station. Improvements to the Neckar include the cutting of entirely new stretches, e.g. two canals between Mannheim and Heidelberg, where the shortening of the channel was facilitated by the flatness of the Upper Rhine Plain. Other cuts have been made just below Heilbronn, and again through the loop of the Neckar past Heilbronn itself. A number of other straight cuts had been completed several years prior to 1939, mainly near Stuttgart and Cannstatt, and again at Plochingen, where in future a river port will be developed. These modifications of the Neckar have been made piecemeal, and, before the war, navigation ceased at Lauffen, a few miles above Heilbronn.

The costly improvements which have been planned and carried out can hardly be justified by the amount of local traffic, although this has grown considerably in recent years. The pre-war traffic carried between Lauffen and Mannheim on the Neckar was less than half that conveyed on the Main between Aschaffenburg and the Rhine confluence. Apart from Stuttgart, a leading industrial town of south-west Germany, and the neighbouring smaller manufacturing centres, the Neckar basin contains few centres of industry, though its economic products are rather more diversified than those of the Main. Coal and coke from the Ruhr, iron ore, other metals, petroleum, timber and building materials, such as bricks and cement, form the chief commodities carried.

The potential importance of the Neckar depends in part on the construction of the Neckar—Danube canal.

The Neckar—Danube Canal

This project was envisaged as a future alternative route between the Danube and the Rhine to the Danube—Main—Rhine canal. It involves building a canal from Plochingen, a point 124 miles up the Neckar, across the Swabian Jura to Ulm on the Danube. The short length of the canal compared with that needed to link the Main with the Danube is an obvious advantage, but the high cost of the scheme in view of the steep gradients involved will probably long delay its execution. In any case, the utilization of such a canal depends upon the improvement of the 105-mile stretch of the Danube between Ulm and Kelheim (see p. 577).

The Waterways of North-Western Germany

Between the Dutch frontier and the Jutland peninsula, the rivers draining to the North Sea comprise the Ems, Weser and Elbe,

The Waterways of North-western Germany

Waterway	Length (miles)	Max. barge capacity (tons)	Tonnage carried, 1937 (thousands)
Ems, from Emden to Herbrum	34·8	over 3,000	6,439*
Dortmund-Ems C.			
from Herbrum to Bergeshövede	65·2	1,500	7,410
from Bergeshövede to Datteln	55·3	1,500	11,089
from Datteln to Dortmund	11·8	1,500	5,106
Küsten C., from Dörpen to Elsfleth	43·5	1,000	937
Ems-Weser C. (W. Mittelland), from Bergeshövede to Minden	63·3	1,000	4,177
Weser (with Fulda)			
from Kassel to Minden	144·7	650	1,052
from Minden to Bremen	101·9	650†	2,397
Weser-Elbe C. (E. Mittelland), from Minden to Rothensee (Magdeburg)	83·2	1,000	3,763
Elbe, below Hamburg	65·2	over 3,000	1,158*
Elbe, above Hamburg	385·5	750	12,064
Saale, from Halle to Barby	65·2	500	739
Elbe-Lübeck (Trave) C., from Lauenburg to Lübeck	41·6	1,000	1,585
Kiel (Kaiser Wilhelm) C., Brunsbüttelkoog to Kiel	64·6	ship canal	218*

* Excluding sea traffic.

† The canalization of the Weser to take 1,000-ton barges from Bremen to Minden is believed to be only partly completed.

From official sources.

Fig. 136. The waterways of north-west Germany

Based on official sources.

For key to capacity of waterways, see Fig. 148. Arrows show connecting waterways. Bw. Brunswick; Hm. Hildesheim; L. Leipzig; Osn. Osnabrück. 1 Rhine; 2 Wesel-Datteln C.; 3 Datteln-Hamm C.; 4 Rhine-Herne C.; 5 Ruhr; 16 canalized Ems, Emden—Herbrum; 17 Dortmund-Ems C., Herbrum—Bergeshövede; 18 ditto, Bergeshövede—Datteln; 19 ditto, Datteln—Dortmund; 20 Ems—Jade C.; 21 Ems—Weser C. (W. Mittelland); 22 Weser; 23 Werra; 24 Fulda; 25 Weser—Elbe C. (E. Mittelland); 26 Elbe; 27 Saale; 27a Unstrut; 28 Elbe—Lübeck (Trave) C.; 29 Kiel C.; 30 Küsten C.; 31 projected Hansa C.; 32 Ihle C.; 33 Plauer C.; 34 Lower Havel; 35 Havel (direct route to Spandau); 35a Potsdam Havel; 36 Teltow C.; 37 Oder—Spree C.; 38 Hohenzollern C.; 38a Finow C.; 39 Oder; 27b Halle—Leipzig C. Note: Latest reports show that the Weser (no. 22) can take barges of only 650 tons and the Datteln-Hamm C. barges of only 750 tons.

together with the Elbe tributaries, notably the Saale and the Havel. East-west connexions between these rivers are effected by means of canals, notably the recently completed Mittelland, extending from the Ems to the Weser and the Elbe, with an extension in the Elbe-Havel C. to Berlin. Less important canals are the Küsten and Ems-Jade, joining the lower Ems to the lower Weser. The projected Hansa canal will eventually join the Ems-Weser C. with the Elbe below Hamburg. In the west, the Dortmund-Ems C. links the Ruhr industrial region with the port of Emden. This canal joins the western section of the Mittelland C. at Bergeshövede. The waterway which it is usual and convenient to describe by the one name of 'Dortmund-Ems C.' comprises in fact a canal proper, a length of the river Ems which has been canalized, and a short lateral canal in the Ems estuary.

The Ems

The Ems is the shortest of Germany's chief navigable rivers, with a total navigable length of 54 miles along the stretch lying parallel to the Dutch frontier. The upper part of the Ems is of little use for navigation. The river rises on the western slopes of the Teutoburger Forest, and then crosses the western end of the North German Plain, winding across the Münster 'bay' *en route* to the Ems estuary. The divide between the Ems and the Dutch rivers draining to the North Sea follows the Boertanger Moor. In common with other rivers in north-western Germany, the Ems has a marked winter maximum and summer minimum flow. Ice occurs on the average on ten days in the year (at Lingen) and fast ice on 2·8 days, so that freezing is not normally a serious problem on the river.

A partly canalized stream, the Ems is a section of the link between Emden and the Ruhr—lower Rhine region, formed mainly by the Dortmund-Ems C. Apart from the estuarine section, where vessels of over 3,000 tons may be accommodated as far upstream as Herbrum, the Ems is navigable for sea-going vessels displacing up to a maximum of 3,000 tons upstream to Papenburg, and, above this point, for those displacing 1,500 tons as far as Meppen, where the Dortmund-Ems C. begins. Navigation on the Ems has been improved by the construction of a number of locks, and most of these occur in the stretch between Gleesen and Herbrum, which has been canalized. Nine locks, all 499 ft. long and 33 ft. wide, bring the level up from $6\frac{1}{2}$ ft. to 82 ft. One of these locks is at Meppen. Other locks occur at entrances to lateral canals, such as the sea lock at Papenburg, at the entrance to

the Splitting C., and the Dörpen lock, where the Küsten C. takes off eastwards. Similarly, Leer, a minor seaport, lies below the point where a lock controls the approach to the Leda C.

In the tidal section of the Ems, from Emden to Herbrum, vessels use the natural channel of the Ems, except below Oldersum, where a lateral canal, 6 miles long, enables small craft to avoid the swell of the widening estuary. This canal terminates in Emden harbour, where a sea-lock cuts it off from the estuary. Upstream navigation of the Ems, as distinct from the Dortmund-Ems C., terminates at the weir 12 miles north of Münster; this navigation is carried out only on a small scale.

The country drained by the Ems is able to contribute little to the traffic on the waterway, as it is sparsely populated and mainly agricultural. However, the importance of the Ems as a waterway is due to its canal connexions, these forming a vital link between the industrial agglomeration of the Ruhr coalfield and the North Sea port of Emden. This port has special facilities for the handling of bulk cargoes, notably coal, coke, and iron ore. Most of the upstream traffic carried on the Ems consists, therefore, of raw materials for the heavy industries of Rhenish Westphalia, with coal and coke moving downstream. The Ems and Dortmund-Ems waterways provide the shortest and cheapest haul inside Germany between the North Sea ports and the Ruhr, and one of the most important commodities carried is Swedish iron ore. The total annual traffic was about 6 million tons, but it is notable that this is little more than half the tonnage carried on the Dortmund-Ems C., for a considerable part of this traffic is diverted from the Ems to the Mittelland C., and so to the Weser and Elbe. Since 1939, the decline of the sea-borne trade of Emden has resulted in a marked decrease in the traffic carried by the Ems. Another war-time feature has been the linking of the Ems with the waterway system of the eastern Netherlands.

The most important work in progress in connexion with the Ems is the construction of a lateral canal, parallel to the Ems and the Dortmund-Ems C. above Meppen. This canal is to connect Gleesen, where the Ems-Vechte branch canal leads to the Netherlands, and the sea lock at Papenburg.

Owing to the proximity of the Ems to the Dutch frontier, the connecting waterways nearly all lie to the east of the river. They are the Ems-Jade C., linking Emden with the naval base of Wilhelmshaven; the Küsten C. from a point above Dörpen to Elsfleth on the Weser; and the Ems-Weser C. (W. Mittelland), joining the Dort-

mund-Ems C. at Bergeshövede with the main waterway system of the North German Plain. There is also a canal which connects the Ems and the Dortmund-Ems C. with the waterway system of the eastern Netherlands. This is the Ems-Vechte canal, which takes off westwards half-way between Rheine and Meppen. The Ems-Vechte C. also joins the Süd-Nord C. at Nordhorn, traversing the Boertanger Moor northwards in the direction of Rutenbrock.

The Dortmund-Ems Canal

Completed in 1899, the Dortmund-Ems C. joins the Rhine—Ruhr waterway system at Datteln. The canal winds across the Münster 'bay' in a northerly direction, following a sweeping course almost parallel to the Ems, which it crosses below Münster and eventually joins at Meppen. The total length of the canal and of the canalized Ems (described above) is 167 miles.

The Dortmund-Ems C. was designed to accommodate barges of 750 tons, but widening was in progress in 1938 to admit craft of 1,500 tons. A ship-lift and lock occur at Henrichenberg, below Datteln, enabling vessels to be raised or lowered 46 ft., and the canal crosses the Stever and Lippe rivers by means of aqueducts and the Ems by means of locks, 722 ft. long and 39 ft. wide. The Münster lock lowers the canal 19 ft., 35 miles beyond Henrichenburg. The canal is embanked for some miles north of Münster and at Ladbergen it bifurcates. Continuing northwards, the canal is lowered between Bergeshövede and Gleesen from 164 ft. to 82 ft., by means of seven locks, all 498 ft. by 33 ft. Pumping stations are located at the locks near Datteln, and these enable water from the Rhine to maintain an adequate level in the Dortmund-Ems C. Traffic on the canal is mixed, i.e. it consists of both towage trains and individual vessels, in the proportion of 85% and 15%. In 1938 (i.e. before the enlargement of the canal took place), vessels using the canal comprised the following:

350 tons	80%
350–500 ,,	10%
500–750 ,,	10%

From: *Deutsche Wasserwirtschaft*, Aug. 1939.

The canal is the alternative to the Rhine as the outlet to the North Sea for the Ruhr-Westphalian industrial region. The increase in its capacity resulting from the improvements in progress in 1938, and in relation to the Mittelland C., meant a great economic and strategic gain for Germany. In consequence of this improvement, freight

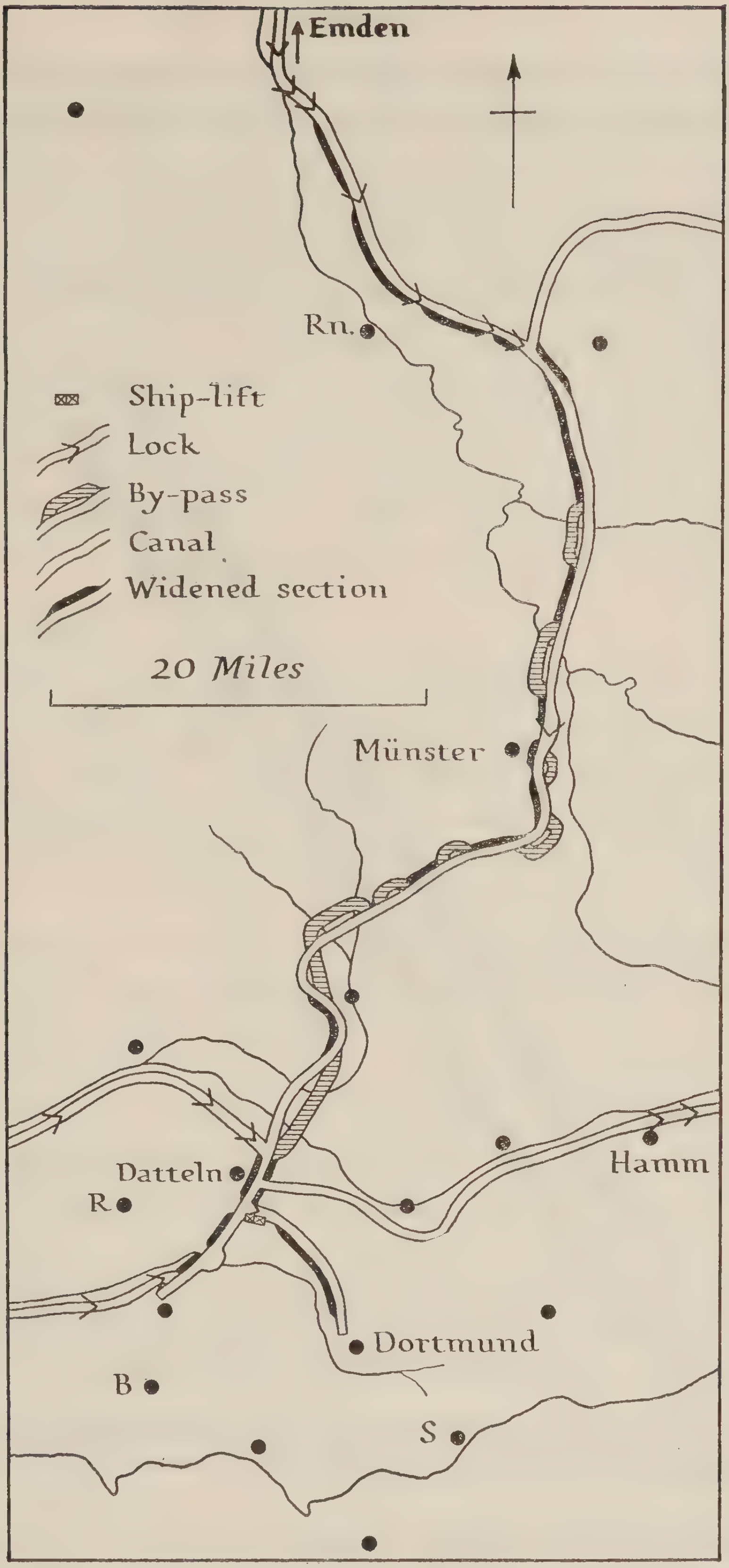

Fig. 137. The southern section of the Dortmund-Ems Canal

Based on official sources.

B Bochum; R Recklingshausen; Rn Rheine; S Schwerte. To cope with the growth of traffic, the Dortmund-Ems C. has been widened in many places and provided with loops or by-passes in others. Details of the junctions at Datteln are illustrated in Fig. 133. The ship-lift shown is situated at Henrichenburg. To the east of Rheine, the Ems—Weser (Mittelland) C. can be seen branching off eastwards; its course follows a curve round the western extremity of the Teutoburger Forest.

could be diverted from railways (inevitably congested in time of war) to the waterways, especially commodities of a bulky, non-perishable kind.

The amount of traffic carried was about 11 million tons per annum. This amount greatly exceeded that on the lower Ems, as much traffic has been diverted eastwards along the Mittelland C. to the Berlin

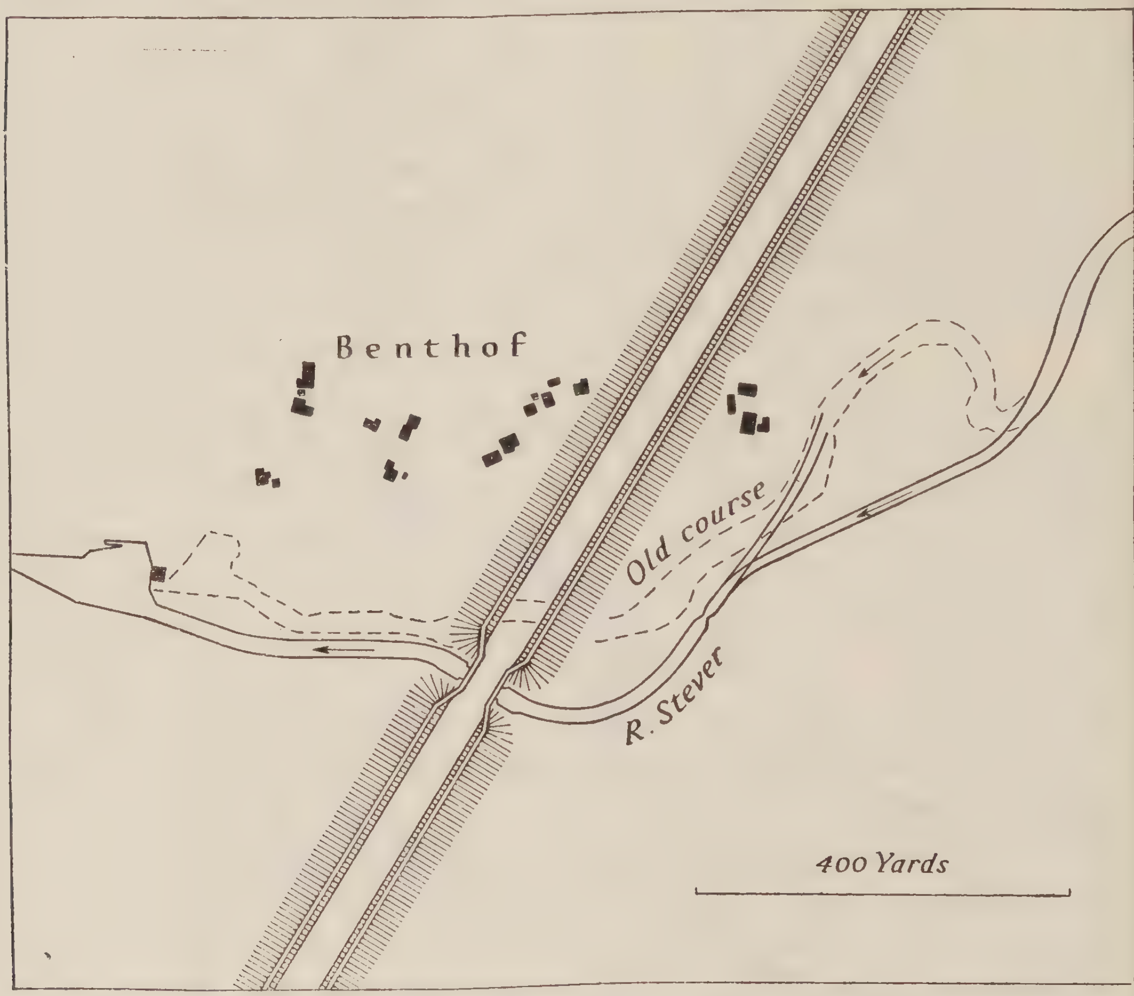

Fig. 138. Dortmund-Ems Canal: Benthof aqueduct and river Stever

Based on Franzius, O., *Waterway Engineering*, trans. Straub, L. G. (Cambridge, Mass., 1936).

The location of this aqueduct is shown on Fig. 133. A considerable diversion of the river was necessary and several houses of the village were removed.

region, Bremen and Hamburg. Coal and coke are by far the most important outward cargoes carried, together with iron and steel goods. Iron ore, building materials, including cement and bricks, chemicals, etc., are the main items moving to the Ruhr.

The most important work in progress is the extension of the Dortmund-Ems C. by means of a lateral canal from Gleesen (Hesselte lock) to Papenburg. This section of the Ems has eleven locks over

a 51-mile stretch, including the one at Hesselte. The completion of this project will mean that an entirely artificial waterway will extend from the Rhine—Ruhr port of Duisburg-Ruhrort to the tidal limit of the Ems and will take vessels of 1,500 tons. This waterway will also connect with the canal system of the Ruhr—Westphalian industrial region, viz. the Wesel—Datteln—Hamm canals, parallel to the Lippe, and the Rhine-Herne C., north of the Ruhr valley. The scheme is said to have been two-thirds completed before 1939. It is closely related to the Mittelland project (completed in 1938). The shortening of the route from the Ruhr to Emden will effect a saving of about 2 days on the present time of 6–7 days. The western end of this canal (Ems-Weser) is at Bergeshövede, opposite Rheine on the Ems.

The Küsten Canal

Completed in 1936, the Küsten C. has been cut from Dörpen to Oldenburg, where it joins the canalized Hunte, which enters the Weser above Elsfleth. The Küsten C. can accommodate vessels up to a maximum of 1,000 tons. There is a lock at Oldenburg. Six miles west of this point is the Edelwechterdamm on the northern side of the canal.

The function of the Küsten C. is to link the lower Ems and Weser in a similar way to the Ems-Jade C. and to bring the Ems into more direct connection with Bremen.

At present, most of the traffic carried by the canal is of local origin. This marshy strip of country in the North German Plain which the canal traverses is sparsely populated. Peat, lignite and building materials are the chief commodities transported. There is also some traffic in foodstuffs, such as cereals, sugar-beet and potatoes.

The Küsten C. will eventually be crossed by the projected extension of the Dortmund-Ems C., above the lock at Dörpen. Subsidiary canals include the Splitting C., which crosses the Küsten C. *en route* to Papenburg, descending by means of six locks. The Leda-Elisabethfehn-Fries C. crosses the Küsten C. *en route* from Leer on the Ems to Friesoythe.

The Ems-Jade Canal

Between the Ems estuary and Jade Bay, the Ems-Jade C. forms a strategic waterway, 46 miles long, linking Emden and Wilhelmshaven. The marshy character of the country greatly facilitated the cutting of the canal: it is a region exhibiting a typical 'polder' landscape, intersected by ditches and dykes.

The canal is at present able to take only vessels of a capacity up to 400 tons. Access to the canal at Emden is gained by means of three locks, which keep out the sea water of the Ems estuary. Apart from these locks, five others occur at 10, 20, 27, 30 and 37 mile distances from Emden.

The importance of the canal is potentially strategic as much as economic, since it links Emden with the naval base of Wilhelmshaven. Traffic is mainly of local origin, such as cereals, peat, cattle, etc. The Ems-Jade C. may be deemed a link, of secondary importance, in the coastal canal system of north Germany, whereby the Ems estuary is brought into connexion with the Elbe estuary, and, in fact, with the Kiel C. by means of the Hadelner C. from Bremerhaven-Wesermünde to the Elbe at Brunsbüttel. South of the Ems-Jade C., 18 miles west of Wilhelmshaven, the Nordgeorgsfehn C. takes off, linking the Ems-Jade with the Leda canal system and so with the Küsten C.

The first section includes eight locks. The Grossfehn C. forms a subsidiary connexion between the Ems-Jade-Nordgeorgsfehn canals and the docks at Emden.

The Ems-Weser Canal (*W. Mittelland*)

From the Ems at Bergeshövede to the Weser at Minden runs the western section of the Mittelland C. which was completed in 1916. The entire canal from the Ems to the Elbe is usually known as the Mittelland C., the component sections being the Ems-Weser and the Weser-Elbe canals respectively. The Ems-Weser C. was in use for a considerable time before the Weser-Elbe, although the latter was used a good deal before the connexion with the Elbe was effected. The entire Mittelland system, in terms of the project dating back to 1905 (see p. 522), includes, in addition to the Rhine-Herne C., the Ihle C., and thus forms a series of waterways connecting the Rhine and the Berlin waterways. The subsequent completion of the eastern section (Weser-Elbe C.) in 1938 established the link in this important east-west canal system of north-western Germany.

The Ems-Weser C., 64 miles long, follows the northern edge of the Teutoburger Forest and the Weser Hills. Problems of gradients have been overcome by means of cuttings, in places 65 ft. deep, and embankments where necessary. The water level is maintained by pumping from the Weser.

This section of the Mittelland C. can accommodate vessels of 1,000 tons maximum. There are no locks between the Ems and the Weser,

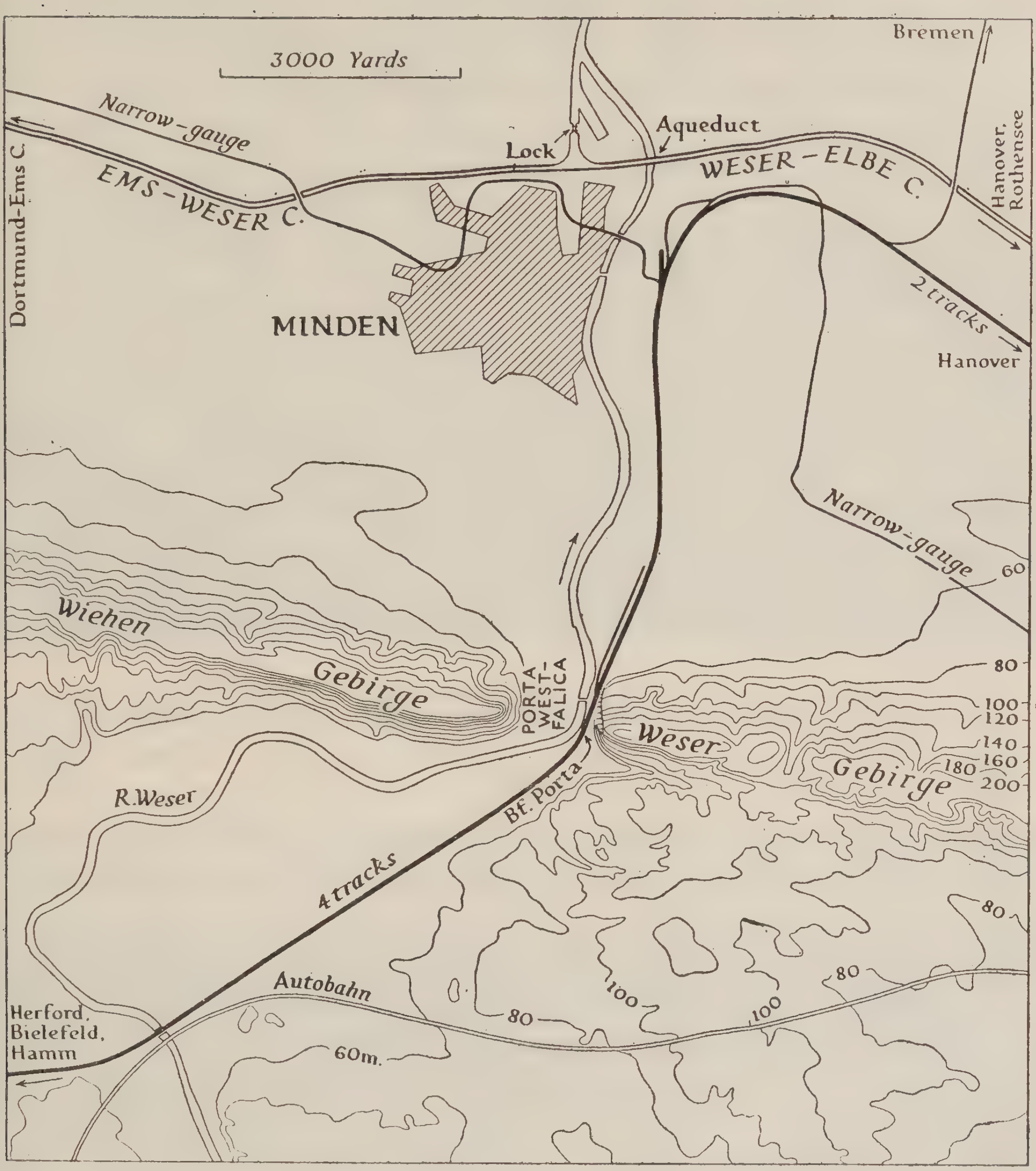

Fig. 139. The *Porta Westfalica* and Mittelland Canal

Based on G.S.G.S. Series 4414, Germany, 1 : 25,000, Sheet 3719, and other official sources.

The *Porta Westfalica* is the gap cut by the Weser (and deepened by ice) through the Jurassic limestone ridge comprising the Wiehen Gebirge and the Weser Gebirge. Through it passes the four-track railway from Minden to Hamm, part of the trunk line from Hanover to the Ruhr. The Mittelland C. runs at the foot of the ridge and crosses the Weser by means of an aqueduct, connexion with the river being made by locks. When the canalization of the Weser is completed (to admit 1,000-ton barges) this junction will become very important, for through it will pass an increased traffic between Bremen and the Ruhr and between Bremen and Hanover. The construction of the Hansa C., however, would lessen the importance of this junction. Bf. Bahnhof. Contours at 20 m. vertical interval.

but at Minden there are two sets of locks, one to lower and one to raise vessels to and from the Weser river. The canal crosses the Weser by means of a stone aqueduct. There are several shore landing places along the canal, e.g. at Bad Essen, Lübbecke, Hille, etc.

The Ems-Weser C. traverses a rich agricultural country (the *Börde* of Hanover), but the traffic moving along the canal is largely derived from the Rhenish-Westphalian industrial region. The canal is an important supplement to the Rhine system and a link via the Dortmund-Ems C. with northern and central Germany, joining the Ruhr coalfield with Bremen, Hamburg and Berlin. The branch canal to Osnabrück, an industrial centre with metal and textile industries, is also much used. The traffic carried by the Ems-Weser C. consists largely of Ruhr coal and coke, together with iron and steel goods, imported petroleum and iron ore, and also building materials, such as cement and bricks, fertilizers, with, in addition, local agricultural produce, such as sugar-beet, potatoes and grain.

The Weser

The Weser drains a comparatively small area of north-western Germany (17,375 sq. miles or 45,500 sq. km.). Its total length (including the Werra headstream) is 478 miles, of which 267 miles lie below Münden, at the Werra-Fulda confluence. These headstreams rise in the Central Highlands of Germany, the Fulda on the northern slopes of the Hohe Rhön and the Werra on the south-western slopes of the Thuringian Forest. Between Münden, where the Weser proper begins, and Minden, the Weser drains the uplands of Hesse and Thuringia, entering the plain tract at Minden. Here the river flows through the famous Porta Westfalica water gap in the Weser Hills. Below this point, the Weser winds north-north-eastwards across, first, the *Börde* country of Hanover, and then the *Geest*. At Verden it enters its marshy valley or *Urstromtal* and follows this glacial channel north-westwards. Here the Weser is joined by the Alle, already reinforced by the Leine (unnavigable) some miles upstream. The combined waters of these rivers enter the Weser estuary at Bremen. The tidal section of the Weser begins at Verden, the long, funnel-shaped estuary widening below Bremen until it is over a mile across at Bremerhaven, 36 miles below Bremen.

Like the Ems, the Weser has a winter and spring maximum flow and a summer minimum. Seasonal irregularity of depth has made various improvements in the river necessary, including the construction of a barrage at Edertal, which serves to regulate the river flow.

Plate 119. Junction of the Mittelland Canal and river Elbe near Magdeburg

Plate 120. The Elbe at Magdeburg, looking south (upstream)

In the foreground is a railway bridge, behind it a road bridge. The city lies to the right; the building on the left is the Stadthalle. In the distance are the chimneys of the *Krupp Grusonwerk*, an important engineering plant.

Plate 121. The Elbe above Dresden

The view shows a paddle tug towing three barges upstream beyond Königstein, where the river occupies an incised valley in the plateau of the Saxon Switzerland. To the left can be seen the Lilienstein, a residual rock mass rising above the surface of the plateau to 1,365 ft. The nearer bank of the river is followed by the double-track railway from Dresden to Prague.

Plate 122. Berlin: the river Spree, looking downstream

In the background are the castle and cathedral

Icing occurs on the average for 14 days per annum at Minden and for 20 days on the Fulda at Kassel. Fast ice, however, is limited to 2·7 and 17·8 days respectively at these two points.

The Weser is greatly inferior to the Elbe as a major waterway. Barge navigation (up to 650 tons capacity) extends as far upstream as Hameln, and, as the result of dredging and regulating, barges displacing up to 650 tons may reach Münden, at the Fulda-Werra confluence. Above this point 650-ton barges may proceed up the Fulda to Kassel, where the canalized stretch of river ends. There are seven locks on this 16-mile stretch, and traffic is inevitably slow and delayed. Above Kassel the Fulda is navigable for vessels of 200 tons or less, and then only as far as Hersfeld. The Werra has recently been deepened so that it can now take barges displacing 400 tons as far as Meiningen.

The navigation of the Weser has been improved by the construction of a number of locks at widely-spaced intervals, e.g. at Hameln, Minden, Schüsselberg, and below Verden. An aqueduct at Minden enables the Ems-Weser (Mittelland) C. to cross the Weser. The canalization of the middle Weser from Minden to Bremen, to enable it to take 1,000-ton barges as far as Hameln, has not been completed. It involved the construction of seven locks, 1,148 ft. by 401 ft.; two power stations were built. Bremen, at the head of the Weser estuary, is the terminus of river barge traffic. In 1938, this port, the second German seaport, handled 3·2 million tons of traffic, 1·4 million of which was river traffic.

The Weser owes its significance as a navigable waterway to the fact that it links Bremen by way of the Mittelland C. with the Ruhr and Rhine to the west, and with Hanover and Berlin to the east. In consequence, most of the river-borne traffic originates outside the rather restricted Weser basin, which is mainly an agricultural region.

The hinterland of the port of Bremen inevitably overlaps with that of Hamburg, and both serve the Ruhr and Berlin regions. Moreover, the Weser, an all-German river, has to compete with the Rhine, in addition to the Elbe waterway, and so carries less traffic than either of these rivers, nor does it tap countries outside the Reich, as do both these rivers. The amount of traffic carried annually by the Weser is of the order of less than $2\frac{1}{2}$ million tons. This rather limited use of the waterway (the Elbe carried 12 million tons in 1937) is partly to be explained by the short length available for large-scale barge navigation, pending improvements now under way, and partly by the specialized trade of Bremen. The raw materials, such as cotton

and wool, imported for Saxony's textile industries, move by rail to their destination in central Germany. Other imports, e.g. cereals, tobacco, coffee and sugar, are dealt with in Bremen itself. The chief downstream items carried are coal and coke, iron and steel goods from the Ruhr, building materials such as bricks and cement, together with timber, while petroleum, fertilizers, chemicals and cereals move inland for subsequent re-distribution.

The upper course of the Weser has been neglected until recently, as it does not serve an important industrial region. Prior to 1939, however, the upper Weser was being improved, so as to take 1,000-ton barges as far as Münden, at the junction of the Werra and the Fulda.

There has existed for some years a project to link the Weser with the Main and thence with the Danube. It involves canalizing the Werra from Münden to Merkers (a work already begun) and thence constructing a canal to the Werra-Itz confluence at Meiningen and thence to Bamberg on the Main. This canal will be 70 miles long and will connect with the projected Main—Danube canal. The Werra was chosen in preference to the Fulda for this purpose, as the Werra-Main watershed is lower and the Itz offers a more practicable route to the Main. Work on the regulation of the Werra between Münden and Wartha near Eisenach is completed. The project involved training the river bed and cutting off meanders, etc., thereby shortening the distance between these two points from 59 miles to 54 miles. No less than eighteen locks are necessary to overcome the considerable gradients encountered. On completion, an alternative waterway will be provided through central Germany from Kelheim on the Danube to Bremen at the mouth of the Weser.

The Hansa Canal

This projected canal will cross the Weser about 10 miles above Bremen and will link the lower Weser with the Ems-Weser C. (W. Mittelland). It will probably serve to draw off traffic from the middle Weser and will eventually be extended across the Weser to the Elbe, which it will enter at Hornburg and also by two branches at Harburg (opposite Hamburg) and Stade.

The Weser is linked by several major canals to the other waterways of northern Germany. The Mittelland system connects the Weser westwards with the Ems and so with the Ruhr-Westphalian industrial region, while eastwards it joins the Elbe-Saale navigation below Magdeburg. The Hunte and Küsten canals join the Weser estuary

with the lower Ems, and the Hamme-Oste and Hadelner-Oste canals provide connexions with the Elbe estuary. The Alle is navigable from Verden, where it enters the Weser, upstream to Celle.

The linking of the Werra with the Main via the Itz would be an important gain to the Weser navigation system. The Weser would, in consequence, be connected to the Danube via the Main, and so Bremen and Hamburg would have direct water communication with the Danubian lands of south-eastern Europe. It is possible that such a route might exceed in importance that of the Rhine—Danube, in view of the fact that the system would lie entirely within Germany. It would not, of course, have direct access to the industrial areas of the Ruhr and Rhineland.

The Weser-Elbe Canal (*E. Mittelland Canal*)

The eastern section of the Mittelland C., completed in 1938, extends from the Weser at Minden to the Elbe at Rothensee, below Magdeburg, a distance of 120 miles. The canal passes Brunswick and Fallersleben, skirting the *Börde* country of Hanover and Brunswick and utilizing a marshy glacial depression (*Urstromtal*). The problem of maintaining sufficient water in the canal is met by pumping from the Elbe.

The Mittelland C. has been built to accommodate vessels of 1,000 tons. There are two sets of locks on the eastern section of the canal: one at Anderten, where the double Hindenburg locks lift vessels 49 ft., and another at Allerbüttel-Sulfeld, lowering the canal 29 ft. The next change in level occurs at Rothensee, 6 miles north of Magdeburg and the present end of the canal. Here a ship-lift provides a descent to the Elbe. This lift is 278 ft. long and 39 ft. wide; it overcomes a difference of 32 to 59 ft., according to the varying level of water in the Elbe. Across the Elbe, the double ship-lift at Hohenwarthe and the Elbe aqueduct, 2,952 ft. long, have not been built (1944). In the meanwhile, the ship-lift at Rothensee enables barges to proceed down the Elbe, or after a short distance to enter the new Niegripp lock, passing thence into the Ihle C., and so via the Plauer C. and the Havel to the Berlin region. The Rothensee elevator is intended, when the project is completed, to deal with vessels going up the Elbe. Vessels going downstream to Hamburg will ultimately cross the Elbe by the projected aqueduct, use the elevator at Hohenwarthe to descend to the Ihle C., and finally enter the Elbe by way of the new lock at Niegripp (Fig. 143).

The completion of the Mittelland C. included the building of a

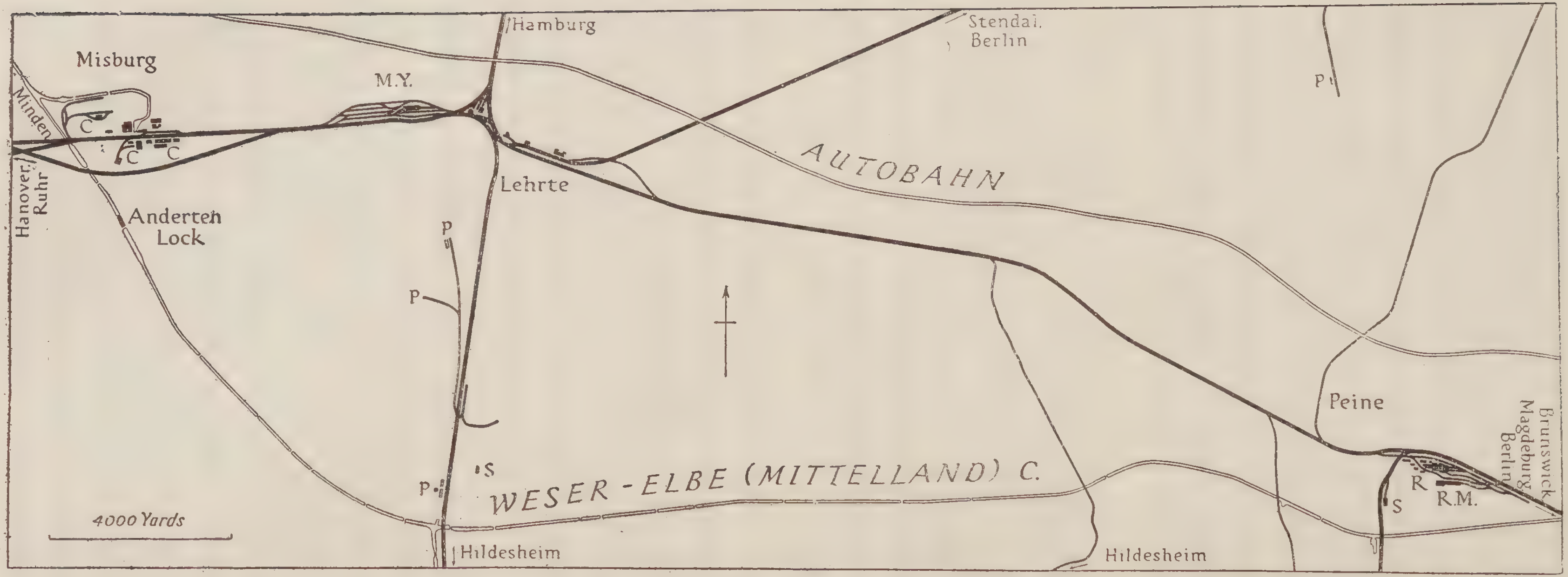

Fig. 140. The traffic artery between Hanover and Peine

Based on G.S.G.S. Series 4414, Germany, 1 : 25,000, Sheets 3624–6.

C Cement works; M.Y. Marshalling yard; P Potash plant; R Oil refinery; R.M. Rolling mill; S Sugar refinery. The thick and thin black lines indicate double- and single-track railways respectively. Hanover lies about one mile to the west. By 1939, the narrow territory shown on the map had become one of the most important arteries of communication in Germany, for through it pass three trunk routes: (1) the Mittelland C., (2) the Berlin—Ruhr autobahn, (3) the Berlin—Stendal—Hanover and Berlin—Magdeburg—Hanover railways, both double-tracked; from Lehrte to Wunstorf (west of Hanover) there are four tracks. Furthermore, the double-track line from Hamburg to Kassel passes through Lehrte from north to south. The Lehrte marshalling yard has a wagon-handling capacity of 4,000 per 24 hours. Lehrte is also a junction on the electricity grid of North Germany—220 kV. transmission lines radiate eastwards to Magdeburg, southwards to Kassel and westwards to Bielefeld. Misburg is the site of the largest oil refineries in Germany apart from those at Hamburg. See also Fig. 142.

branch canal to Hildesheim, between Hanover and Brunswick, with a lock gate at the entrance. These three towns now have good dock facilities and serve a new industrial region in central Germany. In consequence of the cheap transport of iron ore and pig iron, chemicals,

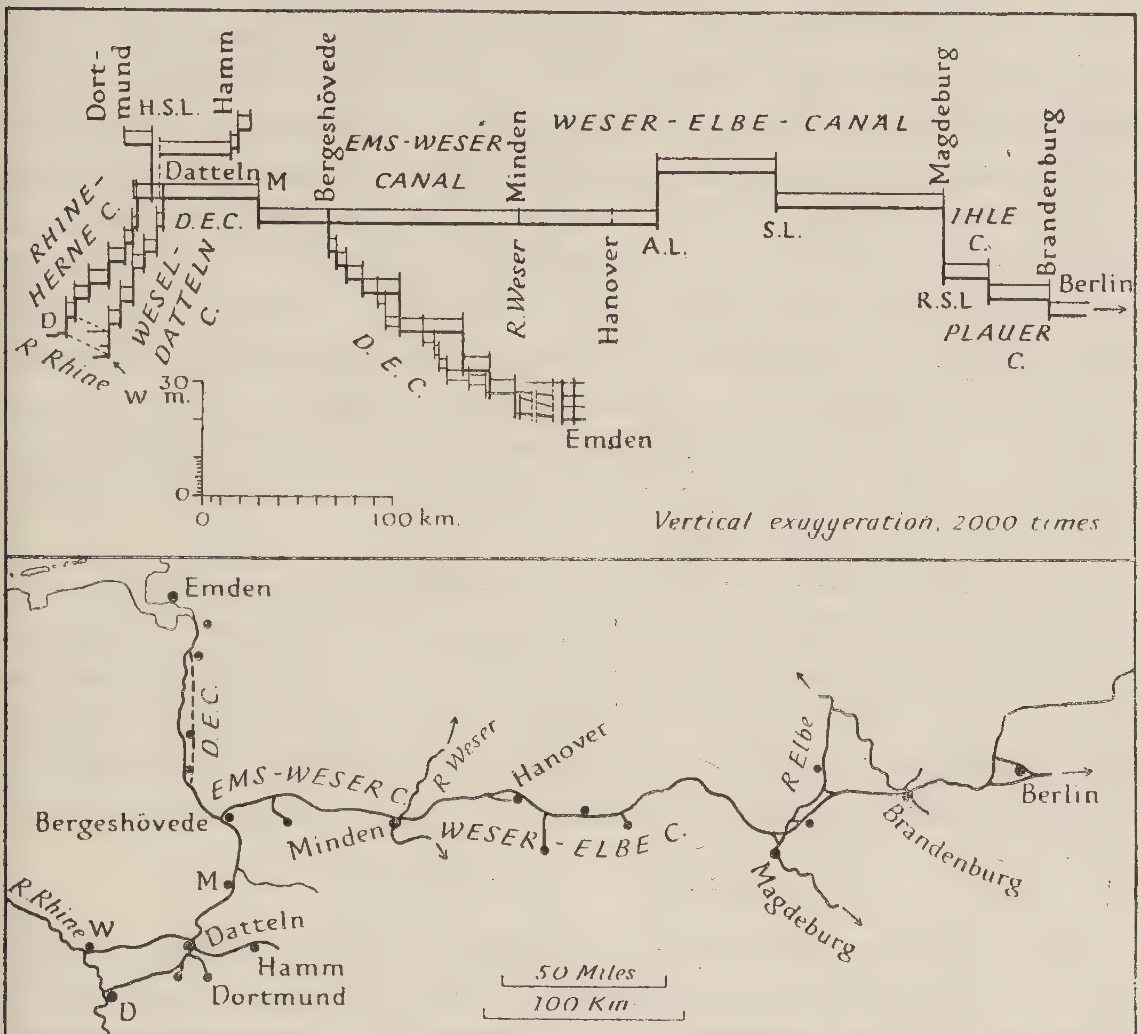

Fig. 141. Profile of the Mittelland Canal

Based on Markmann, *Die deutschen Wasserstrassen* (1938).

A.L. Allerbüttel Lock; D Duisburg; D.E.C. Dortmund-Ems C.; H.S.L. Henrichenburg ship-lift; M Münster; R.S.L. Rothensee ship-lift; S.L. Sulfeld Lock; W. Wesel. The Mittelland C. proper extends from Bergeshövede (on the Dortmund-Ems C.) to Rothensee, near Magdeburg (on the Elbe). Note that the profile is in diagrammatic form, e.g., to show the fall of the Rhine from Duisburg to Wesel the Wesel-Datteln C. has to be shown to the 'right' of the Rhine-Herne C. instead of to the 'left'.

and lignite for electricity generation, new centres of industry have developed recently at Salzgitter, Hallendorf and Fallersleben. Already, in 1939, it was stated in Germany that the *Hermann Göring* works at Blechenstedt would eventually take all the existing capacity of the Mittelland C. The connexion effected by the Mittel-

land C. between the Rhine and Elbe waterways has been an added stimulus to the growth of industry (Fig. 142).

The Mittelland C. owes its importance, therefore, to the fact that it is a main link in Germany's east-west system of water communications, joining the rivers draining to the North Sea with those draining to the Baltic. It serves to connect the rapidly developing Upper Silesian coalfield and industrial region and Berlin with the lower Rhineland and the Ruhr coalfield. In consequence, traffic carried by the canal is mainly in the form of fuel (coal, coke, lignite, briquettes, peat and petroleum) for the industrial plants located in the states of Hanover and Brunswick. Coal and coke also move from the Ruhr to the Elbe and Havel waterways by this route. Conversely, iron ore imported via Hamburg from Sweden; chemicals, including Stassfurt potash salts; Salzgitter low-grade iron ores; together with agricultural produce, such as grain and sugar-beet from the *Börde* country, also utilize the canal. Prior to 1939, long-distance traffic had hardly attained its expected maximum.

The Weser-Elbe C. is linked westwards with the Weser-Ems C. and thence to the Rhine, while eastwards the Ihle-Plauer C. connects with Elbe-Havel and Berlin system of waterways, and so to the Baltic. There are a number of wharves along the canal, especially between Minden and Hanover, and again at Peine and Brunswick, and it is planned to provide additional quays in course of time.

The Elbe

After the Rhine, the Elbe is Germany's most important waterway. Its source lies in the Riesengebirge, in north-eastern Bohemia, and it flows across the Polabi plains of Czechoslovakia, as the Labe, turning northwards below Prague towards the Dresden Gate. At Melnik, it is joined by the north-flowing Moldau (Vltava) which has been canalized to a point 24 miles above Prague (Praha). Below Melnik, the Czechs have improved the Elbe as far as Aussig, the Germans being responsible for the regulation of the river below this point. On entering the North German Plain below Dresden, where it skirts the Leipzig 'bay', the Elbe is joined by the Saale from the south between Dessau and Barby. The river continues on its north-western course along a marshy depression between the heath country of the Fläming and Nieder Lausitz. At Magdeburg, the Elbe describes an elbow bend and continues north-eastwards, then northwards, to Havelberg, where the Havel enters from the east. Below this point, the Elbe again continues north-westwards along the lower

Fig. 142. Communications and industry in the Hanover—Magdeburg region

Based on G.S.G.S. Series 4346, Germany 1 : 250,000, Sheets L.53, M.52, M.53, and other sources.

This region has seen an interesting development of industry in recent years related to its strategic location in the interior of the country, roughly equidistant from the Ruhr, Hamburg, Berlin and Leipzig, and to the transport facilities offered by the railways and by the newly-completed Mittelland C. and Berlin—Ruhr autobahn. Two of the best known of these industries are shown on the map: the *Reichswerke Hermann-Göring* steelworks (R.H.G.) at Hallendorf-Bleckenstedt, and the *Volkswagen* works (V.) at Fallersleben. The steelworks, using ores from Salzgitter brought by a specially built railway, are connected to the Mittelland C. by a branch canal. P.R. petroleum refineries.

Elbe lowland until it reaches the region of partly reclaimed estuarine marshes below Lauenburg. The river drains 54,000 sq. miles and has a total length of over 683 miles, of which 509 are navigable for craft up to 600 tons.

The navigation of the Elbe is difficult in summer in the upper reaches owing to low water. As the result of canalization, there is a mean depth of 6·5 ft. between Melnik and Aussig in Bohemia, but this may drop to 3·5 ft. at low water. At Pirna, 14 miles from Dresden, a reservoir supplies water to the Elbe, but in view of the great variation in level, another barrage is to be built below Magdeburg, where a lateral canal will divert traffic at times of low water. At present there is a minimum of 5·5 ft. above Barby and, below this point, of 6·5 ft. The recently completed barrage in the upper Saale valley at Bleiloch helps to maintain this level, so that between the Niegripp locks (below Magdeburg), at the entrance to the E. Mittelland C., and the Elbe at Barby, there is a channel navigable for vessels displacing up to 750 tons at all seasons. Icing causes more trouble on the Elbe than on any of the other rivers draining to the North Sea.

Mean number of Days with Ice on the Elbe

	Ice	Fast Ice
Dresden	30·8	3·7
Magdeburg	29·8	5·7
Hamburg	34·9	1·0

As the result of regulation, the Elbe and its Czech tributary, the Moldau (Vltava), are navigable for 600-ton vessels in northern Bohemia. Between Prague and Melnik there are five locks, averaging 460 ft. by 36 ft., and, in the regulated section of the Elbe (Labe), between Melnik and Aussig, six locks of the same dimensions. The last of these locks occurs above Leitmeritz, and below this point there are no locks for 230 miles, i.e. over the stretch available for 600-ton barges to Strehla, below Dresden, and thus for 1,200-ton barges to Magdeburg. Here twin locks, 1,050 ft. long, 82 ft. wide and 13 ft. deep, are under construction. Navigation then continues downstream uninterruptedly to Hamburg.

The chief function of the Elbe is to link Germany's leading port of Hamburg across the North German Plain with Berlin, via the Elbe-Havel C. In addition, the river serves a considerable part of Saxony, and its hinterland extends across the Reich frontier into northern Bohemia. The immediate hinterland of Hamburg is thinly

populated agricultural country, but the population density increases in the neighbourhood of Magdeburg, the centre of Germany's sugar-beet production, and it is also high in the industrial region of Saxony which includes such centres as Halle, Chemnitz, and Plauen. Northern Bohemia is a region of rich and varied agricultural production as well as of industrial and mining activities.

Traffic converges on the Elbe from the Berlin region and also from as far east as Upper Silesia where the hinterland of the Elbe overlaps with that of the Oder. The extreme limits of the area tributary to Hamburg may be taken as Breslau in the south-eastern corner of Germany and Prague, the Czechoslovak capital, both over 350 miles from the port.

Hamburg is the terminus for all barge traffic, where there are specially equipped harbours for accommodating river craft (see p. 61); 9·8 million tons of barge traffic were handled in 1938, the leading commodities being coal and coke, together with petroleum destined for Berlin, wheat, timber and wood pulp, iron ore, other metals and chemicals, with, in addition, a wide variety of foodstuffs, fertilizers and raw materials. Chemical fertilizers such as Chilean nitrates, phosphates, and also oilseeds, maize, scrap iron and pyrites, move upstream, particularly to Czechoslovakia. Fertilizers, oil-cake, etc., find their market in Upper Silesia. In return, metal goods converge on Hamburg, together with sugar from Breslau and Magdeburg. Saxony sends glass, briquettes, paper and salt; and Czechoslovakia, sugar, glass and various manufactured goods.

Traffic on the Elbe is divisible into three sections, corresponding to the lower, middle and upper reaches of the river. In 1938, the Elbe from Hamburg to Lauenburg, where the Elbe—Lübeck C. takes off, handled 8·8 million tons, over a stretch of 31 miles. The middle Elbe, from Lauenburg to Wallnitzhafen, a distance of 192 miles, dealt with 6 million tons. The upper Elbe divides into the stretch between Wallnitzhafen and the Czech frontier, which handled 850,000 tons, and the Czech section dealing with 1 million tons. Magdeburg, Dessau (with its well-equipped port of Wallnitzhafen), Dresden, Aussig and Prague are also river ports of importance. Magdeburg handled 2·1 million tons of traffic in 1938 and has two good harbours. Engineering and chemical industries are prominent in the town. Dessau, handling 385,000 tons in 1938, has engineering and food-packing industries. Dresden, with a turnover of 642,000 tons in 1938, has engineering and chemical industries as well as the pottery industry at Meissen downstream. Aussig has a considerable

transit trade in lignite, oilseeds, sugar and timber, and is the largest Czech port on the Elbe. Prague (Praha) functions as a river port on the Moldau (Vltava), dealing especially in sugar, timber, coal, etc.

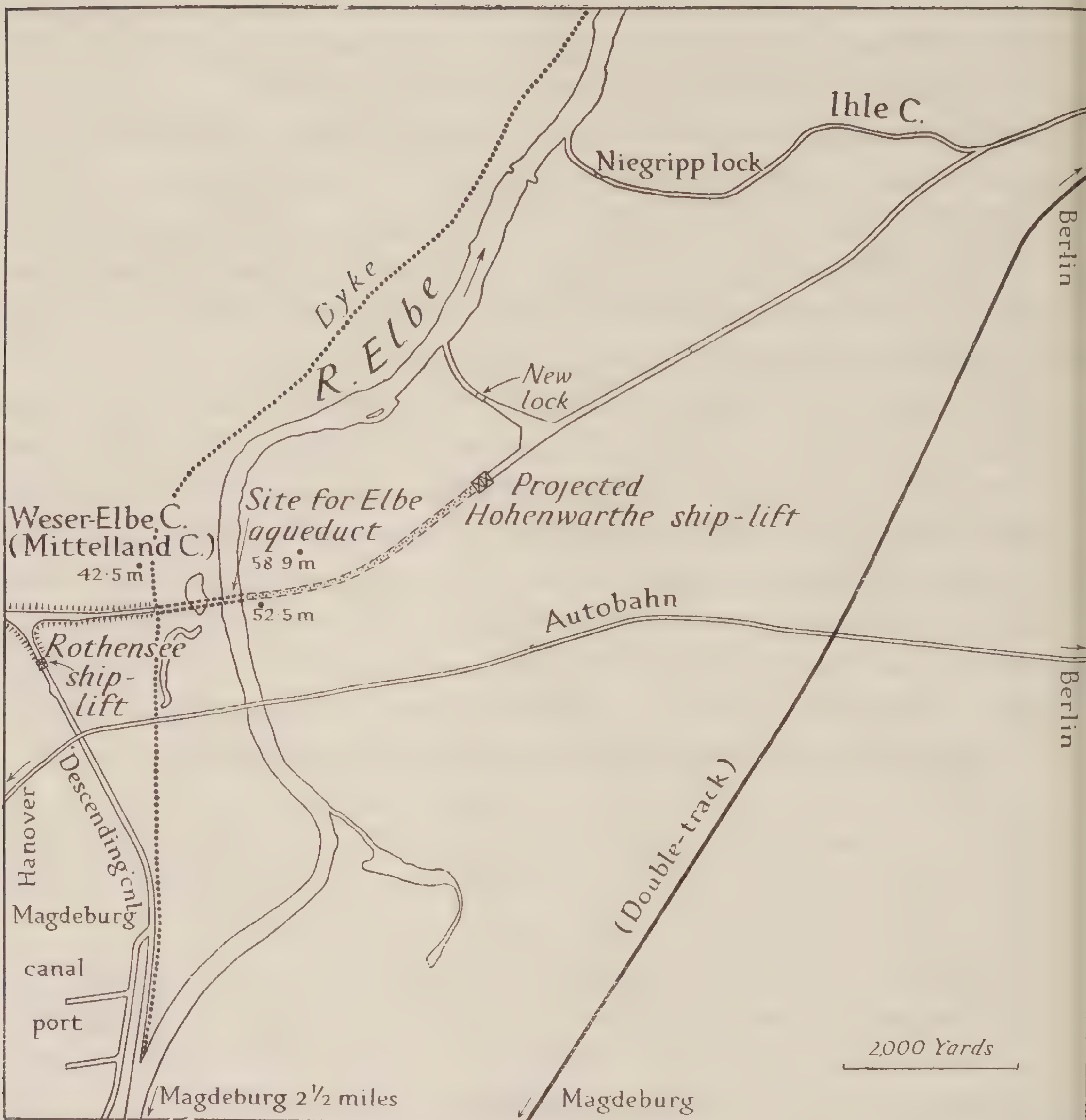

Fig. 143. Rothensee: Mittelland Canal and river Elbe

Based on G.S.G.S. Series 4414, Germany, 1 : 25,000, Sheet 3736, and other official sources.

The Rothensee ship-lift was completed in 1938; the Hohenwarthe double ship-lift and the aqueduct over the Elbe have not yet been built. When the entire project is finished, vessels working between the Mittelland C. and ports down the Elbe will pass through the Hohenwarthe ship and the new Niegripp lock; vessels working between the canal and upstream ports, e.g., Magdeburg, will pass through the Rothensee ship-lift.

The Elbe owes much of its commercial importance to its connexions by means of canals and canalized rivers with other parts of the North German Plain. The chief western connexion is via the W. Mittelland system (Ems-Weser-Elbe C.), which joins the Elbe

at Rothensee a few miles below Magdeburg (see p. 595). This great east-west waterway at present depends on the Rothensee ship-lift, which enables vessels to enter the Elbe and then to proceed eastwards through the Niegripp or the Parey locks to the Ihle and Plauer canals, leading via the Havel to Berlin. Direct connexion between the Mittelland C. and the Elbe-Havel C. depends on the completion of an aqueduct, and the opening of the ship-lift at Hohenwarthe. It is this Elbe-Havel canal system and its extension in the Oder-Spree and the Hohenzollern canals which attract traffic from the upper Oder via Berlin to the middle and lower Elbe. The Elbe and Müritz—Elbe—upper Havel connexion with the Oder is of minor importance. The Elbe—Lübeck (Trave) canal links the Elbe at Lauenburg with the Baltic port of Lübeck (see p. 134). Westwards, the Hansa canal is projected to run from the Elbe at Horneburg to the Weser above Bremen (see p. 594).

The Saale

This 230-mile long left-bank tributary of the Elbe is at present of minor importance as a waterway. The Saale rises on the northern slopes of the Fichtel Gebirge, flows northwards across the complex country of the Thuringian basin, where it is joined by the Unstrut from the west and, below Merseburg, by the Elster from the east. The Saale suffers from an irregular regime and the water level is regulated by means of the Bleiloch dam in the upper part of the Saale valley. This dam also serves the Elbe. Winter freezing closes the river to navigation for about a week on the average.

The Saale, together with the Unstrut below Artern, form a waterway system navigable for barges of 200 tons, but below Halle the Saale can take craft up to 500 tons. Upstream on the Saale, Naumburg, at the confluence with the Unstrut, is the limit of navigation for 170-ton barges. The Saale is being deepened and straightened so as to take craft of 1,000 tons, thereby providing a southern extension of the Elbe waterway into Thuringia. The Saale is linked via Magdeburg with the Mittelland C. and so with the Berlin region, in addition to its connexion with Hamburg down the Elbe. Westwards, the W. Mittelland C. links the Saale with Hanover and Brunswick.

The most important river port on the Saale is Halle, a growing industrial centre which is likely to handle an increasing amount of traffic with the completion of river improvements now in hand. The chief commodity handled by the port is imported pulp and paper

destined for Leipzig, with its printing and publishing trades. At present, the Elster—Saale C., which takes off above the industrial centre of Merseburg, provides a waterway to Leipzig. This canal is regarded as a southern branch of the Mittelland C., but can only take craft up to 400 tons. A harbour is in course of construction at Leipzig. In view of the growing importance of the Merseburg-Leuna district, especially in connexion with the production of liquid fuel from lignite, it is planned to link this centre with Leipzig and Torgau (on the Elbe) by an extension of the Elster—Saale C. The improvement of the Saale up to Merseburg-Leuna is being carried out on account of the increased traffic anticipated between this industrial district of recent growth and the Mittelland C. Coal, coke, lignite and mineral oil are the chief commodities moved by water in this upper section of the Saale.

Elbe—Lübeck (Trave) Canal

From Lauenburg, about 30 miles above Hamburg, the Elbe-Lübeck C. takes off northwards for Lübeck. The canal is 47 miles long and was completed in 1900.

There are seven locks, all 263 ft. long and 39 ft. wide at the entrance. Vessels displacing up to 1,200 tons may be accommodated. There are schemes to modernize the canal, so that it might serve as an important alternative to the Kiel C., between Hamburg, the Elbe and the Baltic Sea. This improvement might also serve to revive the trade of Lübeck, now small compared with the more favoured port of Stettin. Lübeck's turnover in 1938 was only 634,000 tons. It is thought that the Elbe—Lübeck C. may also benefit through increasing use of the Mittelland C., and also through the improvement of the Saale, and the construction of the Saale—Elster connexion with Leipzig. Much of the traffic through the canal originates in the Baltic region, and consists of timber, iron ore, building materials, etc. Manufactured iron and steel goods, coal and grain move towards the Baltic.

The Waterways of North-Eastern Germany

The region to the east of Berlin, as far as the Polish border, is drained principally by the Oder and its tributaries, the Warthe and Netze, to the Baltic. East-west connexions between the Oder and the Elbe are made through the Mark waterway systems, including the Elbe-Havel C. (East Mittelland). Between Berlin and the Oder, the most

important links are the recently completed Hohenzollern C. and the Oder-Spree C. The Oder is also connected with the lower Elbe via the Hohenzollern C. and a devious waterway system which traverses the Mecklenburg Lake Plateau.

A few independent waterways provide navigation channels across northern Pomerania and Mecklenburg to the Baltic coast. These include the Peene river entering the western end of Das Haff at Peenemünde, and the canalized Warnow river, at the mouth of which stands Warnemünde, the outport for Rostock.

The detached province of East Prussia has few stretches of navigable waterway. The most important are the Masurian canal and lake system, the Oberländischer C., and the inner coastal waterway, linking Memel and the Kurisches Haff via the Deime with Königsberg and the Frisches Haff, and thence with the Vistula delta.

The Waterways of north-eastern Germany

Waterway	Length (miles)	Max. barge capacity (tons)	Tonnage carried, 1937 (thousands)
Mark Waterways			
Ihle C.	18·6	1,000	517
Plauer C.	22·3	1,000	1,824
Potsdam Havel	18·0	1,000	2,080
Plauer lake to Elbe	50·3	1,000	2,582
Spandau to Plauer lake	42·2	1,000	4,712
Berlin-Oder System			
Teltow C.	23·6	750	2,480
Oder-Spree C.	80·1	600	11,775
Hohenzollern C.	66·4	750	5,979
Oder System			
Oder (from Kosel to Stettin)	397·7	500	7,984
Oder (from Stettin to Swinemünde)	39·7	3,000	815*
Adolf Hitler C.	—	750	—
Warthe (from Netze to Küstrin)	42·2	600	420
Netze (from Polish frontier)	75·8	600	192
East Prussia			
Nogat	37·9	1,000	145
Pregel-Deime	27·9	600	554
Gilge	58·4	400	509
Memel	39·1	600	712

* Excluding sea traffic.

From official sources.

The Mark Waterways form a complex system of waterways which serve to link the Elbe and the Oder via the Berlin region; the total mileage is 416. The Spree and Havel tributaries of the Elbe are

Fig. 144. The waterways of south-east Germany

Based on official sources.

For key to capacity of waterways, see Fig. 148. Arrows show connecting waterways. L Leipzig; 25 Mittelland C.; 26 Elbe; 27 Saale; 27a Unstrut; 32 Ihle C.; 33 Plauer C.; 34 Lower Havel; 35 Lower Havel to Spandau; 35a Potsdam Havel; 36 Teltow C.; 37 Oder—Spree C.; 37a Friedrich Wilhelm C.; 38 Hohenzollern C.; 39 Oder; 40 Adolf Hitler C.; 41 Netze; 42 Warthe.

utilized for part of the system. It may conveniently be considered in three sections:

1. The Elbe—lower Havel canal system.
2. The Berlin—Oder—Spree system.
3. The Upper Havel—Hohenzollern canal system.

(1) *The Elbe—lower Havel canal system* (*river Havel, Ihle and Plauer canals, etc.*)

Between the middle Elbe and Berlin, the Elbe-Havel canal system forms an extension eastwards of the Mittelland C. The western part of the waterway consists of the Ihle and Plauer canals, and the eastern part utilizes in the main the canalized Havel river.

Ihle Canal. This waterway takes off from the Elbe below Magdeburg and is entered via the old and the new Niegripp locks. It can accommodate 1,000-ton barges. Eighteen miles long, it carried less than a third of the traffic utilizing the Plauer C. prior to 1939.

Plauer Canal. This canal may be entered directly through the Parey lock from the Elbe, or else via the Niegripp locks and the Ihle C. The Plauer C., after a short stretch of 22 miles, enters the Plauer lake, where the Gross-Wüsternitz lock lowers the level of the water 13 ft. Beyond this 22-mile stretch, the regulated waterway of the Havel and a number of lakes provide alternative routes to Spandau, the industrial district to the north-west of Berlin. Two locks occur at Brandenburg, and there the waterway continues to the point where a lateral canal leads northwards to Nauen, and the Havel bifurcates. These two branches converge on Potsdam and the Havel waterway continues northwards to Spandau. East of Potsdam, the other branch of the Havel connects with the Teltow C. A feeder canal connects this branch with the Wann See and so with the Spandau branch of the Havel. The Teltow C. is entered via the Klein Machnow double lock. The southward bifurcation of the Havel is referred to in the table as the Potsdam Havel. The traffic through these waterways consists largely of coal and coke, stone and cement, together with some cereals. The industrial suburb of Spandau is particularly well placed for water transport.

(2) *The Berlin-Oder-Spree Systems* (*Teltow, Oder-Spree Canals*)

Teltow Canal. Connexion between the Elbe-Havel system and that of the Oder-Spree is effected by the Teltow C., 23 miles long and extending from the neighbourhood of the Havel at Potsdam to Königswusterhausen. This canal is devoid of locks east of Klein

Machnow until it joins the Oder-Spree C. at Wernsdorf. It can take vessels of 750 tons. Branch canals lead south-westwards from Königswusterhausen and south-eastwards, linking up with the lakes of the Spreewald. A number of locks occur here.

Oder-Spree Canal. East of Berlin, the Spree has been canalized so as to provide a waterway connecting Berlin with the Oder. Three locks occur in this section: at Wernsdorf, Grosse Tranke, and at Fürstenwalde. At a distance of $7\frac{1}{2}$ miles beyond this the canal enters the Drahendörfer Spree, beyond which is the Kersdorf lock. Eleven miles further east the *Friedrich Wilhelm C.* branches off to join the Oder near Brieskov. This canal is $8\frac{1}{2}$ miles long and has no less than seven locks. The Oder-Spree C. continues to Fürstenberg, where there are three locks, and it joins the Oder 3 miles beyond this point. This canal system was designed between 1879 and 1891 and can only take barges up to 600 tons. However, it carries a considerable amount of traffic, particularly coal and coke, building materials, chemicals, etc.

(3) *The Upper Havel—Hohenzollern Canal System*

Upper Havel. North of Berlin, the upper Havel provides a devious waterway from the Lake Plateau country of Mecklenburg to the Berlin region. The upper Havel is linked through the Müritz tributary and Müritz lake with the Elde river (Müritz-Elde waterway). A branch canal leads northwards (the Stor C.) to the Schwerin lake, while the Elde C. continues to the Elbe beyond Dömitz. The large number of locks on this last canal make it economically of minor importance, and the waterway can only accommodate craft up to 400 tons.

The Hohenzollern Canal. This recently completed canal replaces the older Finow C. with its eleven locks providing a fall of 114 ft., and it follows approximately the same route. A former branch canal of the Finow is used to bring water from the Werbellin lake to the Hohenzollern C. Beginning in the Spandau district north-west of Berlin, the Hohenzollern C. follows the direction of the Spandau C. to the point where the lock at Flotsen See lowers the canal to the level of the Tegler See, through which it joins the Havel. The Havel is followed to Pinnow, and beyond this lock, near Lehnitz, is a lock admitting vessels to and from the Lehnitz lake. Another is to be built here. Over the next stretch between Lehnitz and Liepe there are no locks. At Liepe the Niederfinow ship-lift lowers vessels into the west Oder, 118 ft. below the canal. Alternatively, the descent

Plate 123. Berlin: river Spree and Klingenberg power station

Taken from the east, this view shows the Rummelsburg marshalling yard in the foreground and the Spree in the background with the power station barge dock to the left. This plant, with an installed capacity of 270,000 kW., receives Silesian and Westphalian coal by barge and rail.

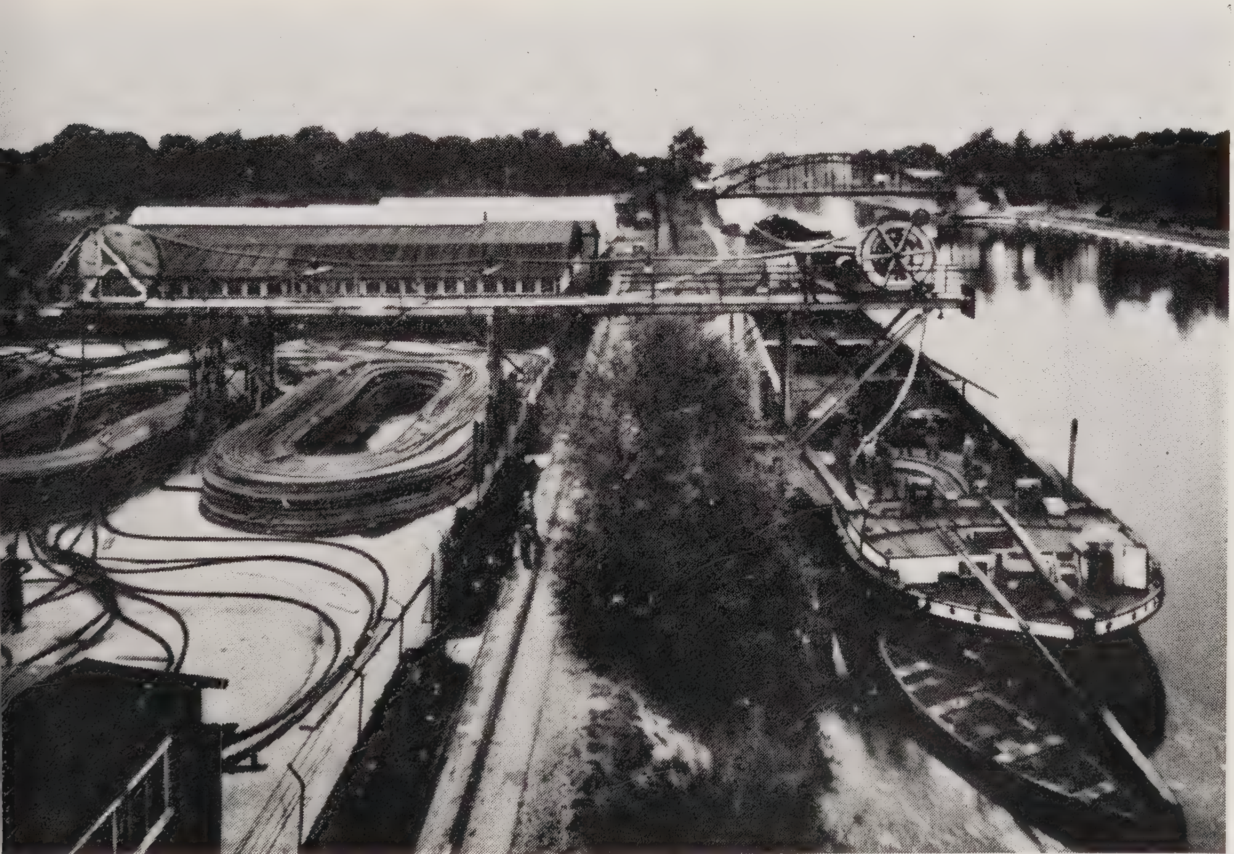

Plate 124. Berlin-Gartenfeld: Hohenzollern Canal and Siemens cable works

This view was taken looking north-west, and shows a cable being loaded on a barge.

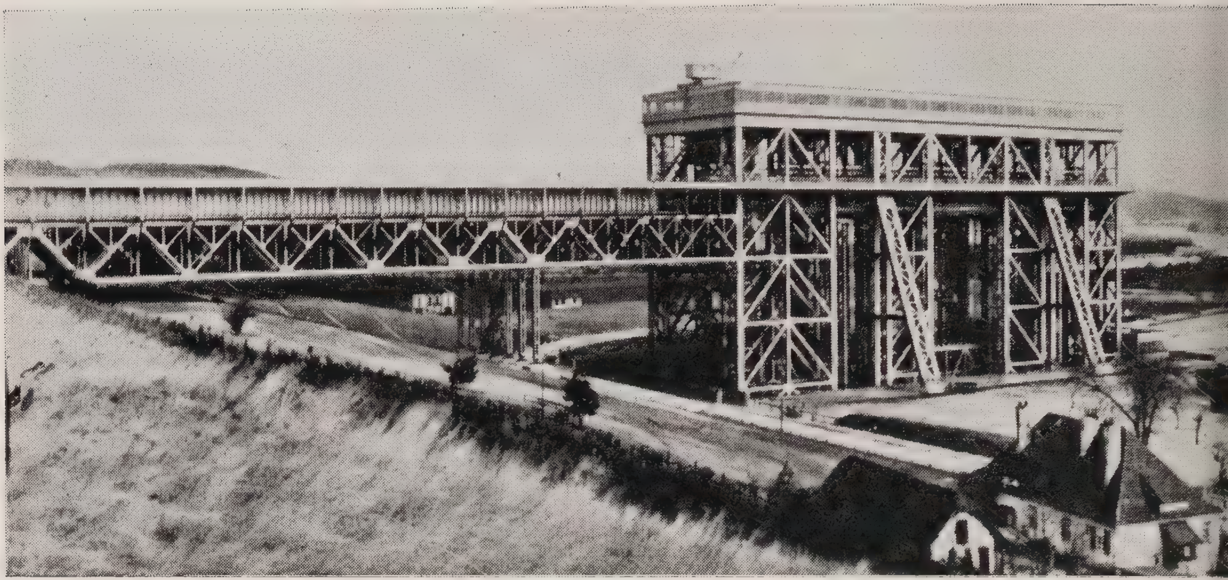

Plate 125. Niederfinow: the ship-lift

This lift permits a rapid passage of barges between the Hohenzollern C. and the partly natural waterway leading to the Oder lateral canal at Hohensaaten. It operates through a difference of level of 118 ft. The illustration shows the abrupt slope between the low *geest* plateau to the left (west) and the wide and flat *urstromtal* of the Oder to the left (Fig. 145).

Plate 126. Breslau: the river Oder and barge port

can be made by a set of three locks. Nine miles beyond this point the canal enters the main stream of the Oder, by means of the two locks at Hohensaaten. The Ruppin C. joins the Hohenzollern C. at Oranienburg, four locks occurring along its extent of 8 miles.

The Hohenzollern C. provides an important link in the Elbe—Havel—Oder waterway system. It forms part of the shortest route

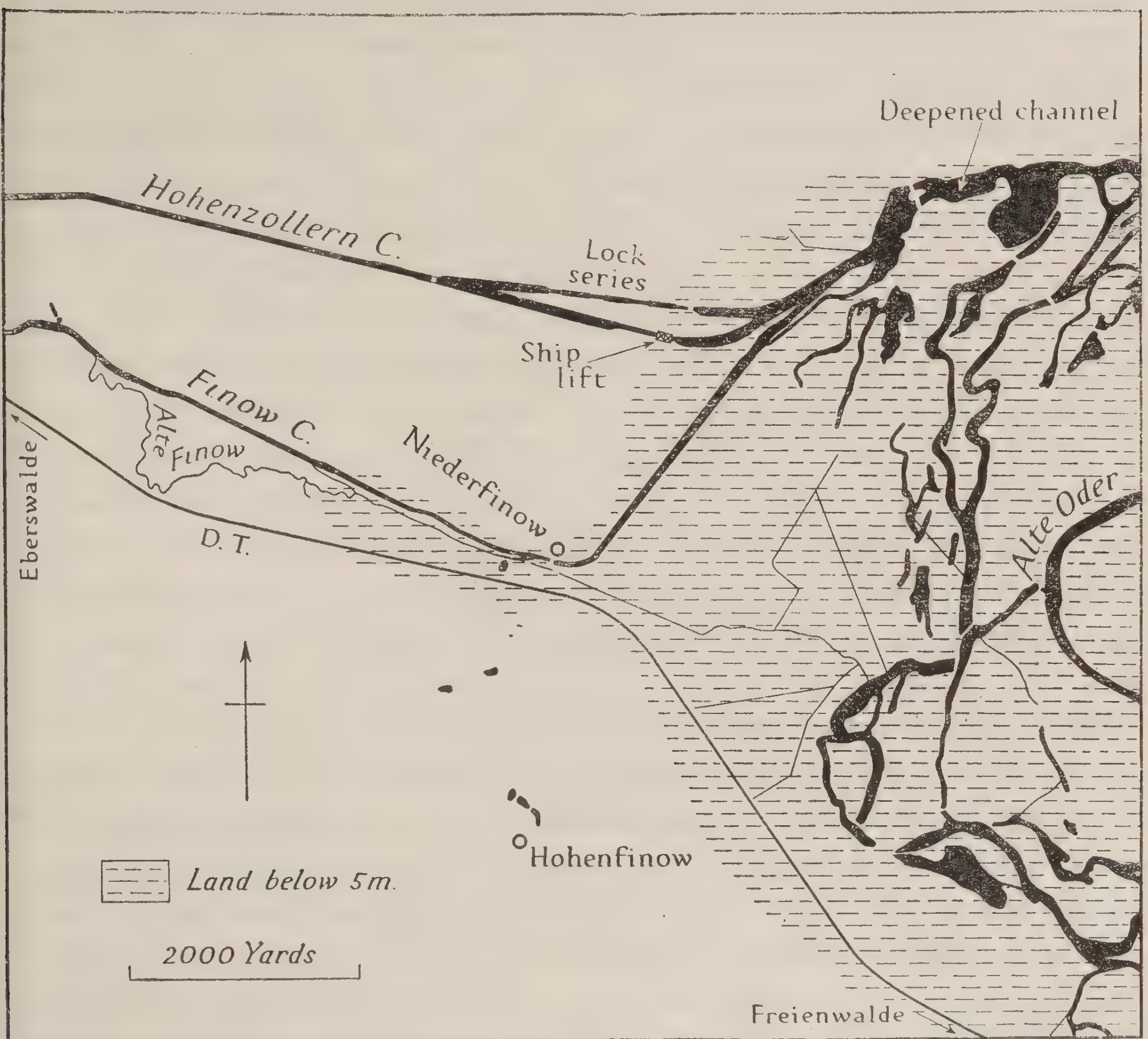

Fig. 145. The Niederfinow ship-lift

Based on G.S.G.S. Series 4414, Germany 1 : 25,000, Sheet 3150.

D.T. Double-track. The shaded area represents the wide valley of the lower Oder, bordered by the low but steep slopes of the sandy *geest* (shown in white). The Hohenzollern C. replaced the earlier Finow C. It descends the side of the valley by a series of three locks, and by the Niederfinow ship-lift, which was constructed to save water and to speed up the passage of barges, thereby increasing the capacity of the waterway between Berlin and Stettin. The Hohenzollern C. is continued in the form of a dredged channel through the stretches of water shown on the map, then through the Alte Oder past Oderberg, to join the Oder lateral canal at Hohensaaten. The Alte Oder, lying in the east of the map, forms parts of a wide westward loop; it is now largely a dead stream, since the course of the Oder, to the east, has been shortened by the cutting through of the neck of a meander between Altcüstrinchen and Niederwützen.

between the Elbe at Magdeburg, Berlin, and the Oder at the bend at Oderberg (Mark). As a waterway available for vessels of 750 tons it forms a Baltic extension of the Mittelland system.

The Oder

The Oder rises in the Odergebirge, at the eastern end of the Sudetes, in the Czech province of Moravia. With a total length of 464 miles, the Oder is navigable over a distance of 397 miles; for regular use the maximum size of barge is 500 tons. Kosel is the present limit of navigation for most traffic, although a little continues across the Czechoslovak frontier to Morava Ostrava (Mährisch Ostrau). The greater part of the course of the Oder lies over the flat country of the North German Plain. After passing through the industrial region of Upper Silesia on the Czech-Polish border, the Oder leaves the Moravian Gate at Oderberg (Silesia). It then winds north-westwards across the Silesian 'bay', past the river ports of Kosel and Oppeln to Breslau, the chief city of south-east Germany. From this point, where the river divides, it continues to Ratzdorf, receiving the Bober and the Neisse from the south in this stretch. The Oder then turns northwards, winding over a wide floodplain, past Frankfurt-an-der-Oder to Küstrin, where the Warthe comes in from the east. Continuing north-westwards to Oderberg (Mark), the Oder finally describes an elbow bend at this point, turning north-north-east towards Stettin, where the river enters the Baltic through Das Haff. In this last section, the Oder flows across a floodplain several miles wide and innumerable channels mark former courses of the river.

As the result of modern regulation, below Oderberg (Mark), where the Hohenzollern C. comes in from the west, the river flows in two branches; thus there are two wide navigable stretches of river between Oderberg and Stettin: the West and East Oder. The western branch, which has a direct connexion with the Hohenzollern C., and on the west bank of which stands the port of Stettin, carries more traffic than the East Oder.

The Oder has the most unfavourable regime for navigation of all the chief German rivers. It suffers from low water in summer, following severe floods which characterize the spring months. Owing to the easterly position of the river, it experiences freezing for a longer period than any other river of the North German Plain. Ice occurs on 29 days at Ratibor, in Upper Silesia, but on 43 days at Frankfurt-an-der-Oder. Fast ice occurs on the average on 15 days at Ratibor and on 19 days at Frankfurt-an-der-Oder.

In consequence, much regulation and improvement have been necessary to maintain sufficient water to keep the level regular during the dry season and to control the flood water in the spring. Twelve locks have had to be built in the upper reaches of the river, the supply of water from the headstreams being insufficient without regulation by means of reservoirs. The largest of these reservoirs are at Oltmachau on the Neisse and the Turawa dam on the Malapane. Similar works are under construction at Stalwerder on the Klodnitz, below Gleiwitz, and these will also maintain sufficient depth of water in the new Adolf Hitler C. Another barrage is being built at Berghof on the Weistritz, and these sites, with their associated power stations, are to be linked with the Upper Silesian grid system. The Oder has also been regulated below Breslau.

The lower Oder is intended, in conjunction with the Hohenzollern C., to take vessels of 1,000 tons from Stettin to Berlin, as well as up the Oder to Küstrin, Frankfurt-an-der-Oder, Breslau and Kosel. Until 1940 this last town was the chief traffic terminus on the Oder, but with the opening of the Adolf Hitler C. Kosel has lost some of its importance as a transhipment point. Barges displacing less than 400 tons can proceed upstream from Kosel past Ratibor across the Czechoslovak frontier to the mining and industrial centre of Morava Ostrava, on the upper Oder.

The Oder, in spite of its natural drawbacks, is the leading waterway of eastern Germany, providing a diagonal route across the North German Plain between the Upper Silesian coalfield and industrial region and the Baltic coast at Stettin. By means of its important canal and river connexions, it is also linked with the Berlin region and with western Germany, as well as eastwards with the Vistula. Stettin, Frankfurt-an-der-Oder, and Breslau are the leading towns located on the banks of the Oder, and Kosel, together with Küstrin are important transhipment points. Stettin, Germany's leading Baltic port handled 8·3 million tons of traffic in 1937 (see p. 165).

Breslau, the regional capital of the province of Silesia, deals with a considerable amount of river traffic (700,000 tons in 1938). The goods handled are chiefly related to the metal, engineering, chemical and light industries located in the neighbourhood. Kosel, however, deals with the greatest tonnage of river-borne traffic, especially downstream from Upper Silesia. Coal and coke are the most important items handled and this feature is also characteristic of Maltsch, an even more specialized port for the Upper Silesian coalfield.

Downstream traffic on the Oder is mainly derived from the in-

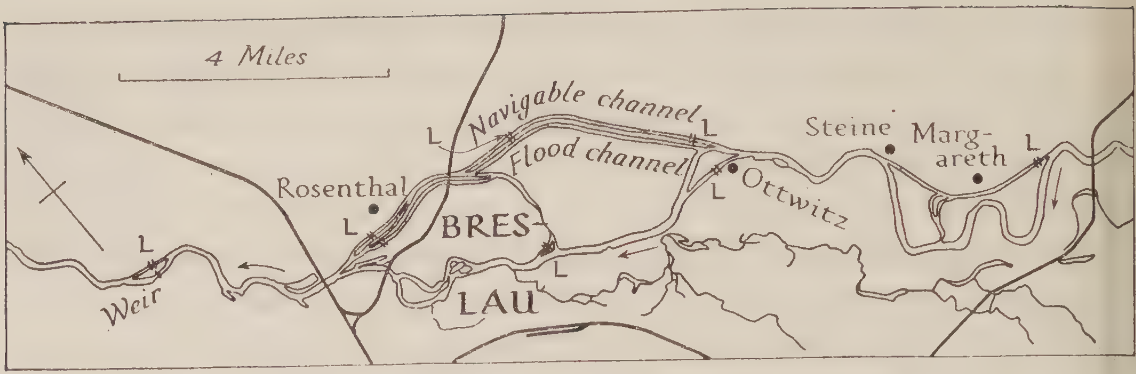

Fig. 146. Old and new channels of the Oder at Breslau

Based on *Die Wasserwirtschaft Deutschlands und ihre neuern Aufgeben* (1921).

L Lock. Much of the straightening of the Oder channel at Breslau was carried out in 1891–7 and 1917.

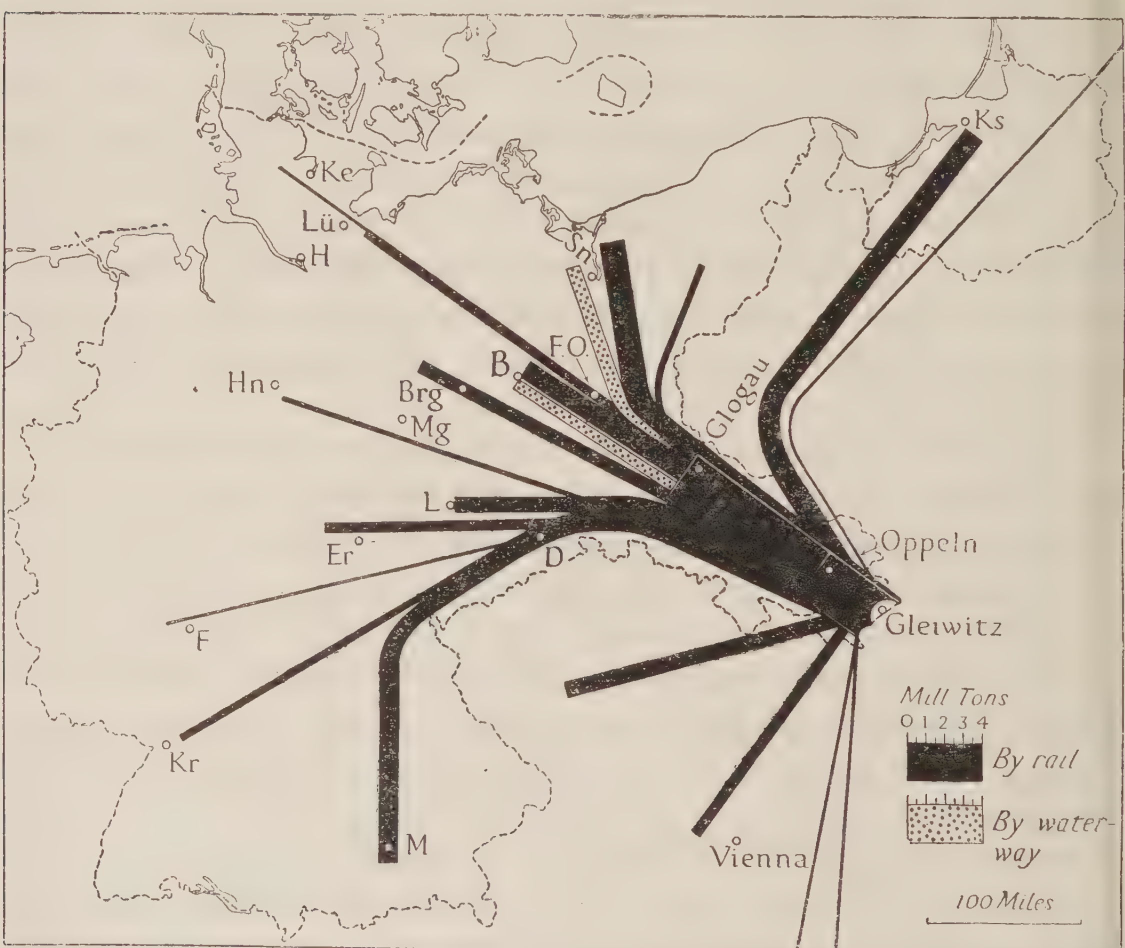

Fig. 147. Movement of coal from Upper Silesia by waterway and rail, 1933

Based on Gaye, J., 'Der Adolf Hitler-Kanal', *Jahrbuch der Hafenbautechnischen Gesellschaft*, vol. 16, p. 2 (Berlin, 1938).

B Berlin; Brg Brandenburg; D Dresden; Er Erfurt; F Frankfurt-am-Main; FO Frankfurt-an-der-Oder; H Hamburg; Hn Hanover; Ke Kiel; Kr Karlsruhe; Ks Königsberg; L Leipzig; Lü Lübeck; M Munich; Mg Magdeburg. The superiority of the railway for long-distance traffic is not surprising, but it should be noted that the railway carried more coal to Berlin and to Stettin than the waterway.

dustrial district of Upper Silesia, amounting to 800,000 tons annually. Whereas coal, coke and iron, and steel goods formed the bulk of the traffic, there was some movement of agricultural produce, such as rye, wheat and sugar-beet. Upstream traffic consisted largely of Swedish iron ore imported via Stettin, a port which competed with Hamburg for traffic to and from Upper Silesia.

The opening of the Adolf Hitler C. (1940) has resulted in an expansion of water-borne traffic via the Oder (see p. 614). An important consequence has been the development of Gleiwitz, on the Adolf Hitler C., rather to the detriment of the river trade of Kosel. Gleiwitz now has direct connexions with the Oder via the Adolf Hitler C., and handles an increasing traffic in coal, coke, iron ore, etc. A project has been put forward to link the Oder with the Danube. This scheme is the eastern counterpart to the Rhine-Main-Danube project in western Germany. A canal is to take off from the Oder near Kosel to Prerov and is planned to lead through the Morava valley to the Danube above Bratislava (Pressburg). Owing to the height of the divide (1,295 ft.) on this route, the problem of maintaining an adequate level in the canal is a serious one. Such a scheme, however, if completed, would open up the agricultural countries of the lower Danubian lands as a market for the products of Silesian heavy industry. An east-west canal between Leipzig and Breslau is also suggested.

Apart from the recently completed Adolf Hitler C. from Gleiwitz to Kosel, there are important lateral connexions between the Oder and the other navigable waterways of the North European Plain. At Fürstenberg the Oder-Spree C. takes off westwards to Berlin, and, at Küstrin, the Warthe flows into the Oder from the east. The Warthe—Netze—Bydgoszcz (Bromberg) canal system connects the Oder with the Vistula.

The Adolf Hitler Canal

This canal is the modern version of the old Klodnitz C. which links Beuthen, in Upper Silesia, with the Oder at Kosel. The Adolf Hitler C., which was completed in 1940, was designed to supersede the inadequate Klodnitz C. and to provide water communication between the coalfields of Upper Silesia, on the Polish and Czechoslovak border, and the Oder navigation. Kosel, long the limit of navigation on the Oder, has good river port facilities and these have recently been improved. There are now three anchorages where the

Adolf Hitler C. enters the Oder, and Kosel has special facilities for the handling of coal in bulk. Before 1940, this river port handled 3·85 million tons annually. However, since that date, it appears that the bulk of the coal traffic has been transferred to the newly developed port of Gleiwitz, at the head of the canal, completed in 1940.

The Adolf Hitler C., which crosses and re-crosses the Klodnitz C. between Kosel and Gleiwitz, climbs to the summit of the divide between the Oder and Vistula drainage, by means of a series of locks, with associated pumping stations. There are six pairs of locks which enable the canal to attain the height of 728 ft. at Gleiwitz. Barges of 750 tons can be accommodated.

This canal, linking a great coalfield and centre of heavy industry in Upper Silesia with a major navigable river, the Oder, offers interesting analogies with the Rhine-Herne C. and may have similar future importance.

The Netze—Warthe Waterway

The Oder navigation is linked to that of the Vistula by means of two of its tributaries entering the Oder from Poland. These are the Netze and the Warthe, which join above Landsberg and enter the Oder at Küstrin, some 20 miles below Frankfurt-an-der-Oder.

The Warthe (Polish: Warta) is navigable for vessels of between 400 and 600 tons as far as Poznan (Posen). The Netze is crossed by the Polish frontier at Kreuz and leads eastwards to Bydgoszcz (Bromberg). Here the short Bromberg C. connects the Netze with the Vistula, at its elbow bend some 25 miles below Torun (Thorn). Thus there exists through water communication between Stettin, the Oder, the Vistula and Danzig.

These two rivers, which drain westwards across Germany's eastern frontier, have rather a variable regime, suffering from winter freezing, spring and early summer flooding, and low water later in the year. They both flow along the extensive marshy depressions known as *Urstromtäler*. One of these depressions was utilized in the construction of the Bromberg C. The country traversed is mainly agricultural, producing a surplus of grain and sugar-beet. Owing to the frontier position of these waterways they have not been much improved and neither carries an important amount of traffic; the chief items are agricultural produce, chemical fertilizers, peat and other fuel. The Warthe carries twice the traffic of the Netze in spite of that river's connexion with the Vistula.

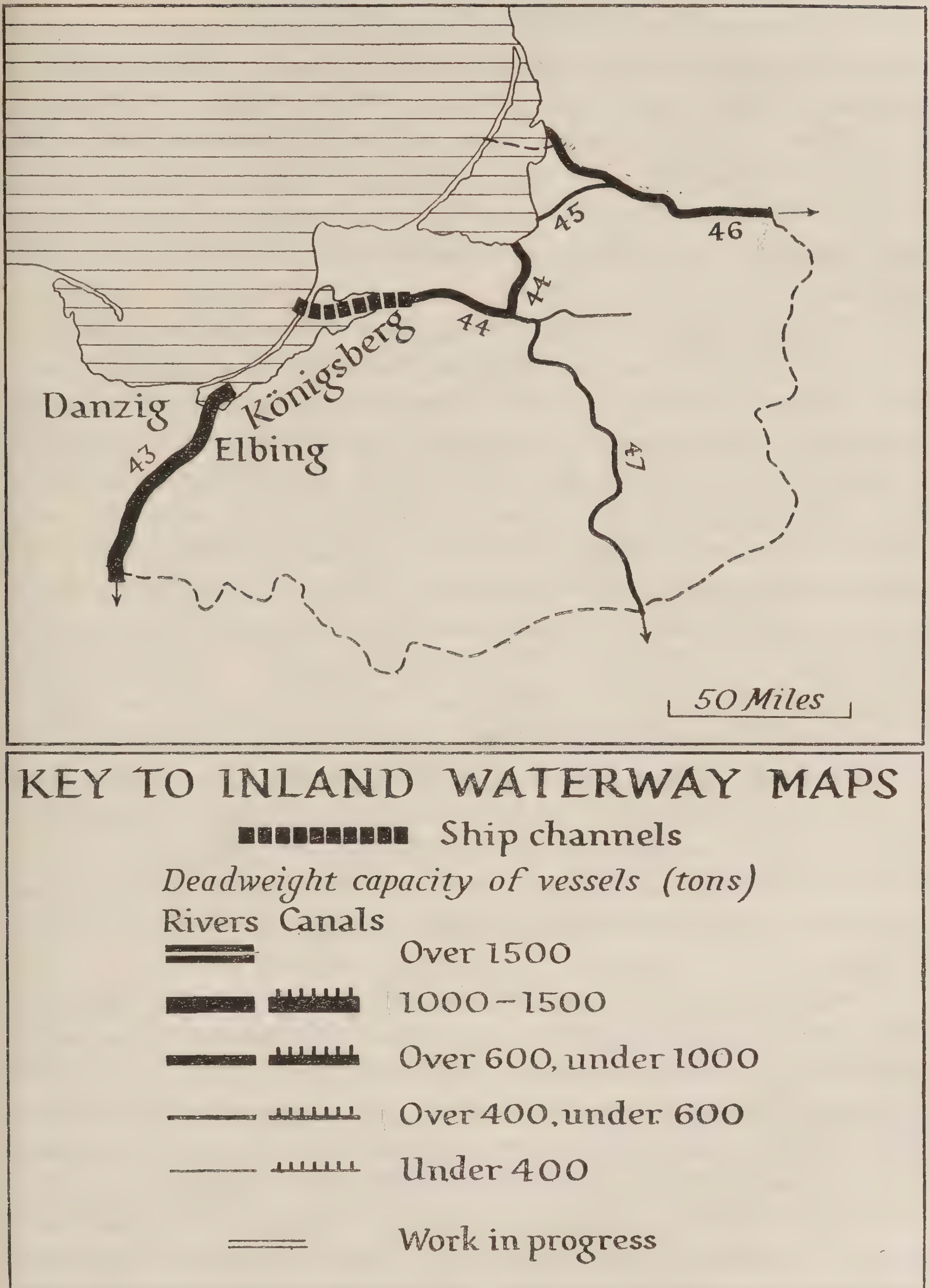

Fig. 148. The waterways of East Prussia

Based on official sources.

Arrows show connecting waterways. 43 Nogat; 44 Pregel—Deime; 45 Gilge; 46 Niemen; 47 Masurian C.

The East Prussian Waterways

In the detached province of East Prussia, communication by water is of minor importance. A number of short streams drain this highly glaciated lowland to the Baltic, but provide few facilities for navigation. The only rivers of any commercial significance are the Pregel, Deime, Memel and Gilge. These streams, which lie in the north of the province (the Memel forms the frontier with Lithuania), are chiefly used for the conveyance of timber from the fir forests of this region.

In the central part of the province, the complex drainage has been utilized to form a continuous waterway from the Spirding and Mauer lakes via the Masurian C., to the Pregel and the Deime and so to the Kurisches Haff and the Frisches Haff. This Masurian C., completed in 1940, has been cut between the Mauer lake and Allenburg and is 31 miles long. It can accommodate 400-ton barges. The only other East Prussian canal lies in the west, near the Polish border. This is the Oberländischer C. and it links Deutsch Eylau in the south, via the Geerich lake and Elbing, with the Frisches Haff. A branch leads eastwards to Osterode. This canal is linked to the Vistula delta through the Nogat branch which forms the frontier of East Prussia in the west. In consequence, there is a connexion between the East Prussian waterways and those of West Prussia, via the Vistula, the Bromberg C., and the Netze and Warthe tributaries to the Oder, but for political reasons, there could be little through traffic. Most waterway traffic in East Prussia consists of the distribution inland of coal and other commodities brought by sea to Königsberg and Elbing.

A special feature of East Prussia is the inner coastal waterway. This feature enables vessels to pass from Memel, at the northern entrance to the Kurisches Haff, through the Haff and so by the Deime and Pregel rivers to Königsberg, at the head of the Frisches Haff. Vessels displacing between 400 and 600 tons may proceed thence through the Frisches Haff to Elbing or to Danzig and the Vistula delta. The completion of the Masurian C. means that there exists a complete circular waterway in northern Poland and East Prussia utilizing the Narew, Bug, and Vistula rivers in Poland and the coastal waterway, Pregel river, Masurian C., and Mauer and Spirding lakes in East Prussia, in turn connecting with the Narew. In view of the sparse settlement and economic unimportance of most of the country traversed, this waterway system is of very minor commercial significance.

War-time Conditions, 1939–44

With the outbreak of war the waterways were called upon to relieve the railways of some part of the increasingly heavy traffic which they had to deal with. This function of the waterways in time of war had not been absent from the thoughts of those who had urged their expansion in time of peace.

Various measures were put into effect to bring about a transfer of many bulk consignments from rail to barge, amounting to prohibition of railway carriage in certain instances. Not only bulk cargoes were concerned, however, for a number of new services operated by self-propelled craft were established on the waterways to improve their ability for carrying express goods traffic. The occupation of the Low Countries and of France in 1940 was undoubtedly an advantage for the operators of the German waterway network, for unified control of all the rivers and canals of north-western Europe simplified the direction of traffic, and any possible shortage of German waterway craft could be supplemented by the use of French, Belgian and Dutch craft.

The waterways had to meet the difficulties imposed by shortages of labour and of certain materials, by the black out and by Allied air attacks. Waterways and craft, however, were generally maintained in good condition. Measures such as a prohibition of the use of barges as floating warehouses permitted a more intensive use of available equipment. As far as possible, new construction of craft was undertaken in order to increase the capacity of the fleet. Such building was strictly limited to certain types: the Mittelland Canal barge, the Grossplauer barge (freight and tanker), and Motor Tanker. The capacity of the waterways was further increased by better organization of towing trains, so that there was less unused towing capacity, and by the extension of navigation during the hours of darkness. The labour shortage remaining after all available German labour had been absorbed was met by directing the personnel attached to Dutch and Belgian barges to continue working when their barges were moved to western Germany, and by employing foreign semi-skilled labour, partly civilian and partly prisoner-of-war.

Organization

A series of administrative organizations handled the management of the waterways, controlling allocation of freight, labour and replacements, and directing the movement of traffic. A responsibility of the

special Traffic Commission, this work was nominally under the direction of the Reichsminister for Transport, but in practice inland water traffic was managed by the divisional offices (*Schiffahrtsstellen*) of the Reich Transport Group Inland Shipping (*R.V.B.*). A special decree of 1941 placed the supervision of waterways under an Inspector-General appointed by Speer, Minister of Armament and Building, as far as technical matters were concerned, but traffic organization remained in full control of the Ministry of Transport. A decree of 1943 extended the control exercised by Speer in transferring to the Reich the waterways formerly controlled by the *Länder* and provinces.

Traffic

The diversion of traffic from the railways, and the increased activity of the country in the conditions of war-time, led to a substantial increase in waterway traffic. No official figures have been published since 1937, when the total amounted to 133 million tons, but it is estimated that the tonnage handled had increased to 160 million tons in 1942 and possibly to 180 million tons in 1943 (these figures, it should be remembered, apply to a wider area than the figures for 1937, owing to the inclusion within the German frontiers of Eupen and Malmédy, Alsace-Lorraine, Sudetenland, Warthegau, etc.). After making allowance for the interruption of traffic at times by air attack, and for the great decline in the Duisburg—Rotterdam traffic, it is clear that the waterway network went far to fulfil one of the functions claimed for it, viz., the release of part of the Reichsbahn's carrying capacity for urgent military needs.

Considerable changes in the direction of traffic took place: north—south movements declined, while west—east movements increased. The traffic along the Rhine at the Dutch frontier had amounted in 1937 to 26 million tons upstream and 33 million tons downstream: by 1943 the traffic declined to an estimated figure of 1,250,000 tons in both directions together. The part which Emden might have played was reduced very considerably by the air attacks on the Dortmund-Ems C. The great decline in the foreign trade of Hamburg, as a factor tending to reduce barge traffic from the port, was offset to some extent by the increased use made of Hamburg for the transport of iron ore from Sweden. It is probable that the Mittelland C. carried a heavily increased traffic, for it forms a direct water route between the Ruhr and Magdeburg, as well as providing cheap transport for new war factories such as the *Volkswagen* works at

Fallersleben and the *Hermann Göring* steelworks at Hallendorf, as well as for the older industrial centres of Hanover and Brunswick.

Waterway Developments

No striking new developments took place since the outbreak of war. The Dortmund-Ems C. was in course of being enlarged (see p. 586), and the Adolf Hitler C. was completed in 1940 (see p. 613). Work on the Main—Danube canal and on the improvement of the Neckar was continued at a rate which varied very considerably. The canalization of the Weser from Bremen to Kassel has not yet been completed. The Mittelland C., although connected with the Elbe in 1938 by the completion of the Rothensee ship-lift, still awaits its more elaborate connexion by means of the aqueduct across the Elbe and the double ship-lift at Hohenwarthe. Preparatory work for the aqueduct had been started, but some time after the outbreak of war was discontinued.

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Appendix I

CIVIL AVIATION

The Reich Air Ministry, or *Reichsluftfahrtministerium*, was founded in May 1933. At first it dealt officially with civil aviation only, although from the beginning it included the German A.R.P. organization, or *Reichsluftschutzbund*, which had been formed a few weeks before the Air Ministry. Air re-armament was proclaimed in March 1935, a few weeks before the re-introduction of conscription into Germany, and the Air Ministry then officially took over the control of military aviation. The ministry is organized on a regional basis. There are thirteen *Luftämter*, or Air Offices for civil aviation, at Königsberg, Stettin, Berlin, Dresden, Münster, Munich, Stuttgart, Breslau, Hanover, Hamburg, Wiesbaden, Köln and Nuremberg, while another at Vienna was added after the *Anschluss*. For military aviation there are nine *Luftgaue* or Air Commands, at Königsberg, Berlin, Dresden, Münster, Munich, Breslau, Hanover, Wiesbaden and Nuremberg; others were added at Vienna after the *Anschluss* and at Poznan after the outbreak of the present war.

Other departments concerned with civil aviation and under the control of the Air Ministry are the Meteorological Service (*Reichsamt für Wetterdienst*), the Naval Meteorological Office (*Deutsche Seewarte*), and three important schools for aeronautical inspection and general flying safety (*Reichsschule für Luftaufsicht*, the *Reichswetterdienstschule*, and the *Flugssicherungsschule*). Technical aspects of flying, aeronautical research, and the relations between the aircraft industry and the operating companies are furthered by a considerable number of technical institutes, notably the *Lilienthal Gesellschaft für Luftfahrtforschung*, the *Deutsche Akademie der Luftfahrtforschung*, and the *Reichsverband der Deutschen Luftfahrtindustrie*. All of these are under the direct control of the Air Ministry, and there are in addition a considerable number of state-subsidized institutes at the various universities and technical high schools, which come under the Ministry of Science, Education and Instruction.

Civil aviation in Germany is virtually a monopoly of the *Deutsche Lufthansa A.G.* (D.L.H.), the only other services operating in 1938–9 being the air freight lines (*Reichsbahn Frachtstrecken*) of the *Deutsche Reichsbahn* (German State Railways). Companies which had ceased operation in the years prior to 1939 were the *Deutsche Verkehrsflug A.G.*, which closed down in 1934, the *Deutsche Zeppelin-Reederei*, and the *Deutsche-Russische Luftverkehrs A.G.* (*Deruluft*), both of which closed down in 1937. Several extra-European companies, mainly in South America, are in various ways German-controlled. Subsidiary companies of D.L.H. are *Hansa Luftbild G.m.b.H.*, which is concerned with air survey and photographic work, and the *Hansa Flugdienst G.m.b.H.*, which provides a private hire service.

The policy pursued in civil aviation for a number of years prior to the outbreak of the present war was undoubtedly largely controlled by political and military influences. The South American airlines, for example, were heavily subsidized to compete with local and with United States companies, large numbers of personnel were trained for the *Luftwaffe* (in fact, at one time only men on the *Luftwaffe* reserve were allowed to join D.L.H.), and the *Nationale-Sozialistisches Flieger Korps* (N.S.F.K., or Nazi Flying Corps) was of very great importance.

The Development of Civil Aviation

German civil aviation had its origins in 1917, when the *Deutsche Luftreederei* was founded. This company survived the Armistice, and in 1919 the first service

was operated, from Berlin to Wismar, and was followed in the same year by lines from Berlin to Hamburg, to Hanover and the Rhineland, to Warnemünde, and to Swinemünde, and from Hamburg to Westerland on Sylt. When in 1920 the German government agreed to subsidize civil aviation, several new companies were formed, notably the *Lloyd Luftverkehr Sablatnig*, *Lloyd Ostflug*, and *Deutsche Luft-Lloyd*. The *Luftreederei* and *Sablatnig* concerns operated international lines from Berlin to Amsterdam, to Copenhagen and to Malmö. In 1921 was formed the important *Deutsche-Russische Luftverkehrs A.G.*, which extended air-lines eastwards from Königsberg to Smolensk and Moscow. The progress of civil aviation was helped by the repeal in 1922 and 1923 of several restrictions imposed by the Treaty of Versailles, and Germany was allowed to build certain types of aircraft under the supervision of an Allied Control Commission.

In 1923, the various air-line companies amalgamated into two competitive organizations, the *Deutscher Aero-Lloyd* and the *Junkers Luftverkehr*, but after two years of intensive rivalry the two firms themselves amalgamated into the *Deutsche Lufthansa A.G.* This firm, together with the *Deutsche-Russische Luftverkehrs A.G.*, which had stayed outside the original amalgamation, was subsidized by the government on the basis of distance flown. Other grants were provided by various towns and municipalities which had airfields, while the government became responsible for the provision of airfields and of meteorological and other technical facilities. The capital of D.L.H. was fixed at RM. 25 millions, and the shares were taken up by the Reich (26%), the German States (19%), regional air transport companies (27½%), and private investors (27½%). The government department in control of civil aviation until 1933 was the Reich Transport Ministry (*Reichsverkehrsministerium*), which had the assistance of a consultative body, the *Beirat für das Luftfahrtwesen*.

In 1926, a new agreement was signed in Paris between Germany and the Allies, which re-defined the terms upon which Germany was to be allowed to further civil aviation. The German government agreed to prohibit the construction or acquisition of military aircraft, military training of pilots was forbidden, and there were certain special regulations for the Rhineland. Upon the compliance of Germany with the stipulations, the Inter-Allied Air Control Commission was withdrawn, the Zeppelin works at Friedrichshafen were restored to Germany, and agreements were made between France and Germany for air services between the two countries. The Berlin—Köln—Paris line was run from the summer of 1926 by D.L.H. and the French company *Lignes Farman* in conjunction.

Germany had been excluded from the International Air Convention of 1919 as an enemy state, and subsequently, when the member states expressed their willingness to allow Germany to join, that country held aloof on account of certain discriminating clauses which remained operative against ex-enemy countries. Nevertheless, Germany was ready to negotiate agreements with other countries, and was party to most of the international conventions, such as the Carriage by Air Convention of 1929 at Warsaw and the Air Sanitary Convention at The Hague in 1933. However, a number of air navigational regulations in force in Germany differed widely from those laid down by the International Air Convention.

D.L.H. was a member of the International Air Traffic Association, and with the support of the government entered into a large number of international agreements and pooling arrangements. Thus in 1926 a pooling agreement was reached with Swiss and French companies on the Berlin—Stuttgart—Basel—Lyons line; with Great Britain in the same year by which the Berlin—London line was flown all the way by German aircraft instead of changing to K.L.M. machines at Amsterdam; with Czechoslovakia in 1927, which opened the Berlin—Dresden—Prague—Vienna line, and with Poland in 1929, which allowed German and Polish aircraft to fly over each other's territory on various east European services. By 1928, D.L.H. was operating some ninety lines, and the Reich was spending some RM. 40–60 millions

annually on civil aviation, about half of which went directly to D.L.H. as a subsidy. In 1929, as a result of financial difficulties, the government was obliged to reduce its subsidy to about half. However, D.L.H., by effecting certain economies, such as the reduction of the number of German airports from sixty-six to fifty-two and of the number of short-distance services, was able to maintain a fairly sound financial position, and indeed to continue the extension of its international lines.

After the advent of National Socialism, civil aviation was increasingly heavily subsidized to an extent generally considered to be far in excess of normal commercial requirements. This policy was continued after the formation of the new Reich Air Ministry. By 1937, D.L.H. was operating directly seventy-six lines, including several extra-European services, and had interests in a number of airlines in other parts of the world (see p. 626). In that year too, D.L.H. took over the internal and international routes operated by *Deruluft*; this firm, subsidized by both Germany and Russia, had operated lines from Berlin to Danzig, from Königsberg to Moscow via Kaunas and Veliki Luki, and from Königsberg via Riga and Tallinn to Leningrad. It was dissolved for political reasons. Zeppelin services, which had operated regularly for a number of years, ceased in 1937 (see p. 629).

The following table summarizes the development of civil aviation since 1919: the last year for which detailed and complete statistics are available is 1937. Subsequent to that year, the international situation was abnormal, while such statistics as were published by Germany must necessarily be more or less suspect.

Year	No. of machines	Total distance flown (1,000 miles)	Passengers		Freight		
			Total (1,000)	P/km. (million)	Goods (tons)	Mail (tons)	Total (1,000 ton-km.)
1919	—	360	2·0	—	—	—	—
1920	27	298	4·0	—	5·7	6·4	—
1921	34	1,038	6·8	—	—	—	—
1922	50	748	7·7	—	37	32	—
1923	72	446	8·5	2·1	39	5	9
1924	107	984	13·4	3·3	71	22	41
1925	142	3,076	55·2	10·6	521	287	178
1926	168	4,065	84·6	14·6	1,057	551	311
1927	194	6,195	151·1	27·0	2,326	627	681
1928	200	7,115	120·7	28·7	2,164	350	873
1929	177	6,474	96·8	23·8	2,070	385	915
1930	181	6,749	93·7	23·8	2,176	481	1,006
1931	166	6,424	98·2	25·7	2,231	406	1,076
1932	170	5,758	98·5	28·2	2,119	384	1,037
1933	174	6,552	123·0	38·3	2,520	467	1,269
1934	174	8,863	165·8	62·7	3,218	772	1,897
1935	149	9,940	209·9	85·9	3,892	1,401	2,966
1936	138	11,111	286·3	123·5	4,848	2,597	4,183
1937	126	11,704	323·1	120·6	4,967	3,754	4,172

Based on statistics from the publications of the International Convention for Air Navigation, and from successive volumes of the *Statistisches Jahrbuch für das Deutsche Reich* (Berlin).

Note: (1) The figures for the number of machines include airships during 1934–7; (2) The numbers of passenger/kilometres and of ton/kilometres are figures obtained by multiplying the number of passengers and of tons carried respectively by the distance they are conveyed. It gives as a rule a more accurate estimate of 'work

done' by the air-lines than do the absolute figures of number of passengers or of tons. As passenger/km. and ton/km. are merely indicative of trends, it has not been considered necessary to convert them into passenger/miles or ton/miles respectively; (3) In 1928 two changes in statistical methods were introduced. A passenger by air who had made a break in his journey had hitherto been counted as two passengers: now he was counted as one. The carriage of newspapers *Zeitungs-spezialdienst*) was transferred from 'mail' to 'goods' for statistical purposes.

Personnel and Aircraft

Until 1937, all operating personnel employed by D.L.H. were trained at commercial flying schools run by the firm. The total number employed increased from 226 in 1928 to 426 in 1937, although the number of pilots remained relatively constant (134 to 148), and the main increase was in the number of wireless operators and of mechanics. In 1937, a government decree disbanded all civil flying schools, and all entrants to civil aviation had to do their training in the *Luftwaffe*, while vacancies in civil aviation were to be filled by men on the *Luftwaffe* reserve. In 1938, however, the D.L.H. schools were reopened.

In December 1937, D.L.H. had 116 registered commercial aircraft. The main type was the *Junkers Ju. 52*, which could be used as a landplane or converted to a float-plane; sixty-one of these were in operation in 1937. Other aircraft which came into service, particularly on the extra-European services, included the *Junkers Ju. 86*, the *Heinkel He. 111*, the four-engined *Focke-Wulf FW 200 'Condor'* and *Junkers Ju. 90*; the *Dornier-Wal* and *Blohm und Voss Ha. 139* sea-planes, with ranges of 2,300 and 3,100 miles respectively, were used on the South America service.

European Services

The main European routes operated in 1937 by D.L.H. were as tabulated on page 625.

This table gives only the terminal points of scheduled through-routes. Many of the lines made intermediate calls at German and foreign airports; thus the Stuttgart—Lisbon line called at Geneva, Marseilles and Burgos, the Berlin—Helsinki line at Danzig, Königsberg, Kaunas, Riga and Tallinn, and the Berlin—Athens line at Vienna, Budapest, Belgrade, Sofia and Salonika. Several of the lines were pooled with other countries; thus *Sabena* shared the Berlin—Brussels route, *K.L.M.* the Berlin—Amsterdam route, and *Air France* the Berlin—Paris route. Most of the services operated throughout the year, although a few, notably the London—Oslo route, did not begin operation until spring, and nearly every one operated daily on week-days.

In addition to the services listed above, D.L.H. operated seven mail and freight lines, which also carried a small number of passengers. These routes were Berlin—London, Köln—Brussels—Paris, Köln—Frankfurt a.M.—Nuremberg—Munich, Berlin—Halle—Leipzig, Hanover—Frankfurt a.M.—Stuttgart, Berlin—Breslau, and Berlin—Köln—Essen—Amsterdam. These carried in 1937 more than a thousand tons of freight and 2·1 thousand tons of mail. In fact, by far the largest customer of D.L.H. was the *Reichspost*, and in 1938 the mail mileage flown increased by 78·5% over that of 1937.

The total figures for the operation of civil aviation in Germany during 1937 include, in addition to D.L.H., the returns of the *Deutsche Zeppelin-Reederei* (see p. 627), of the *Deutsche-Russische Luftverkehrsgesellschaft*, which ceased operation in the spring of the same year, and the *Reichsbahn-Frachtstrecken*. The last of these was owned and operated by the Reichsbahn, and in 1937 four lines were in service. These were from Berlin to Danzig and Königsberg, from Berlin to Breslau, from

Route	Route-length (miles)	No. of passengers	Freight (tons)	Mail (tons)
Internal services				
Berlin—Bremen	216	4,321	29·9	9·9
Berlin—Breslau	180	3,865	28·5	10·2
Berlin—Frankfurt a.M.	280	6,277	60·2	27·7
Berlin—Gleiwitz	275	5,458	38·8	16·6
Berlin—Hamburg	163	23,387	215·2	45·2
Berlin—Karlsruhe	352	11,749	120·1	54·0
Berlin—Köln	306	5,359	47·8	19·2
Berlin—Königsberg	348	11,406	121·6	30·8
Berlin—Mannheim	308	6,987	53·8	63·4
Berlin—Munich	331	20,732	200·9	117·9
Berlin—Saarbrücken	370	4,401	34·1	26·8
Hamburg—Köln	231	3,980	36·2	13·4
Köln—Halle/Leipzig	233	3,312	24·3	10·4
Köln—Dresden	319	9,243	92·4	26·4
Munich—Essen/Mülheim	354	8,431	69·4	24·3
Dresden—Friedrichshafen	396	6,249	49·9	21·7
Frankfort a.M.—Düsseldorf	122	4,224	46·1	22·0
Düsseldorf—Saarbrücken	143	4,987	32·8	5·0
Stuttgart—Bremen	324	6,338	51·9	27·8
International services				
Berlin—Vienna	343	1,945	41·2	3·5
Berlin—Amsterdam	267	3,171	46·4	10·6
Berlin—Athens, via Budapest, Belgrade, Sofia, and Salonika	1,196	10,161	250·6	61·6
Berlin—Brussels	404	9,979	73·8	26·6
Berlin—Helsinki, via Danzig, Königsberg, Kaunas, Riga and Tallinn	876	13,789	184·7	63·7
Berlin—Copenhagen	219	2,293	41·3	4·2
Berlin—London	591	9,343	155·4	44·3
Berlin—Paris	542	6,510	92·6	18·0
Berlin—Rome, via Venice	777	10,533	169·1	32·1
Berlin—Stockholm	512	1,733	29·7	5·9
Berlin—Warsaw	344	2,155	53·4	9·2
Berlin—Zürich	423	7,165	94·7	36·6
Munich—Amsterdam	441	8,501	83·7	25·0
Munich—London	588	7,019	134·0	21·0
Stuttgart—Lisbon	1,319	7,040	186·4	47·0
Amsterdam—Milan	551	3,570	61·6	14·1
London—Oslo	946	5,751	117·1	14·7

From: *Statistisches Jahrbuch für das Deutsche Reich, 1938*, p. 244 (Berlin, 1938).

Berlin to Halle/Leipzig and Munich, and from Berlin to Stuttgart. The lines carried 71·6 tons of freight and baggage and 344·5 tons of mail.

At the beginning of 1939, the sole Austrian civil aviation company, the *Österreichische Luftverkehrs A.G.* or (*Austroflug*), was absorbed into D.L.H. The latter firm continued to operate services within Austria between the airports of Vienna, Salzburg, Graz, Klagenfurt and Innsbruck, and took over the pooled routes to Salonika, Zürich, Venice and Sušak.

Extra-European Services

Germany never operated a regular air-line service across the North Atlantic, although considerable experiments were conducted towards this end, indeed, only

the work of the United States was further advanced. In 1929, a form of air-mail service was opened, whereby the liners *Bremen* and *Europa*, when within range of the coast, catapulted aircraft to fly off ahead of the vessels with the mails. In 1936, twin-engined *Dornier* flying boats were catapulted from special parent-ships, such as were used on the South Atlantic service, and in the following year four-engined *Blohm und Voss Ha. 139* flying-boats were used; these were catapulted off from near the Azores and then flew direct to North America. In 1938, a return flight was made by a *Focke-Wulf 200 'Condor'* aircraft, which flew non-stop between Berlin and New York, and then returned. In that year, there were thirteen return flights made by flying-boats. The total distances flown on the North America service rose from 23,387 miles in 1936 to 44,072 miles in 1937 and 87,112 miles in 1938. The route used was in every case via Lisbon and the Azores, as the northern route via Iceland and Newfoundland was closed to German aircraft for political reasons.

D.L.H. developed a successful South Atlantic service for mail and freight, although a passenger service was never operated. The first flight was made in 1934, when a flight was made to Santiago in Chile by way of Spain, Bathurst, Natal (Brazil) and Rio de Janeiro. Special vessels, equipped with a catapult and crane, and provided with re-fuelling facilities, were stationed in the South Atlantic, at first mid-way between Africa and South America, then nearer the coast. The route flown in 1938 was Berlin, Frankfurt a.M., Marseilles, Barcelona, Seville, Lisbon, Las Palmas, Bathurst, Fernando Po, Noronha, Natal, Recife, Bahia, Rio de Janeiro, Santos, Florianopolis, Porto Alegre, Montevideo, Buenos Aires, Mendoza, and Santiago. The service was not operated throughout by the same aircraft; on the eastern side of the Atlantic *Junkers Ju. 52* and *Heinkel He. 111* were used, for the crossing there were *Dornier-Wal*, *Blohm und Voss Ha. 139* and *Dornier Do. 26* flying-boats, while the American section was operated by the *Condor* syndicate (see below) to 1938 and then by German services. By this service mail was carried from Frankfurt to Santiago in five days. The number of single crossings rose from forty-seven in 1934 to 104 in 1937 and 1938 (i.e. once weekly in either direction). Passengers were carried only as far as Fernando Po, and in 1937 totalled 279.

D.L.H. made a number of experimental flights with the aim of a trans-Asiatic route between Berlin and Tokyo, which was rather in the nature of a political gesture than a project of any great commercial importance. The first stage of this route, 2,628 miles in length, from Berlin to Baghdad via Athens, was opened in 1937, and in the following year extended to Teheran and Kabul. Occasionally stops were made at Brindisi, Rhodes and Damascus.

German-controlled services

The German government pursued in the years prior to 1939 a policy of gaining control by various means of air-lines in other parts of the world, both for political and commercial reasons. In many cases D.L.H. held a considerable proportion of the capital shares in the company, in others the shareholders were German nationals domiciled in the country where the service was operating, in others the *Lufthansa-Junkers* company supplied aircraft and equipment on long-term loan. Most of these lines were run at a loss and were heavily subsidized.

The most important field of activity was South America, where German controlled lines were serious rivals to U.S. concerns. The most important companies were *Lloyd Aereo Boliviano* (L.A.B.), *Syndicato Condor*, *Deutsche Lufthansa A.G., Peru*, *Societe Colombo Alemana de Transportes Aereos* (S.C.A.D.T.A.), *Societe Ecuatoriana de Transportes Aereos* (S.E.D.T.A.), *S.A. Empresa de Viacao Aerea Rio Grandense* (V.A.R.I.G.) and *Viacao Aerea Sao Paulo* (V.A.S.P.).

An important air-line was opened in China in 1933, known as *Eurasia*; it was controlled by D.L.H., used *Junkers* aircraft, and until 1939 its services were flown exclusively by German pilots. The lines operated increased from a total length of

1,200 miles in 1933 to 6,830 miles in 1937; the numbers of passengers carried increased from 720 to 7,210, and the amounts of freight and mail from 6 and 2 tons to 122 and 22 tons respectively in the same period. In fact, in 1938 *Eurasia* operated successfully without a subsidy. The lines flown were (1) Chungking—Sian—Lanchow—Sining; (2) Chungking—Kwelien—Kunming; (3) Chungking—Kunming—Ninghsia; (4) Kunming—Lanchow; (5) Chungking—Hanoi; and (6) Chungking—Hong Kong.

Germany, in common with a number of other countries, was interested in Iceland as a suitable point of call for North Atlantic air-routes. In 1927, a company, the Icelandic Aviation Corporation, was started, and commenced to operate services in 1928, which continued for four years; it was known as the *Flugfélag Islands*. D.L.H. assisted in the operation of this company, and indeed had considerable interests in it, but after incurring losses F.I. went out of business in 1932. During the years 1930–2, the German airman Wolfgang von Grönau called at Iceland on three occasions during trial flights from Germany to America. In 1931, D.L.H. obtained a partial promise that it would have the same operating rights in Iceland as any other foreign company, but owing to political difficulties Iceland remained closed until 1939. In that year, D.L.H. sent a commission to Reykjavík to negotiate for civil aviation rights, and it is understood that the German government intended to make an official request to Iceland to allow the establishment of air-bases there. In view of the international situation in 1939, the Icelanders refused to allow any foreign country to establish such bases, and the commission returned to Germany without achieving any results.

Finally, mention may be made of the Spanish air transport company, *Iberia Companhia Aerea de Transportes S.A.*, which was formed in 1937. It is understood that in 1939 D.L.H. held nearly one-third of the share-capital, supplied the entire fleet of aircraft, and provided a considerable part of the personnel.

Airports

Forty-two airports were available for civil aircraft in 1937, of which thirteen were used by foreign aircraft. By far the most important was the Tempelhof airport at Berlin, followed by Frankfurt a.M., Köln, Halle/Leipzig and Hamburg, on the basis of arrivals of aircraft. The airports on the whole were very well equipped, especially with service buildings; the Tempelhof airport was undergoing extensive re-construction at the outbreak of war. The provision of airports and public landing-grounds is the concern of the *Reichsverband der Deutschen Flughäfen*, which supervises companies controlling individual airports. D.L.H., the government, the districts and municipalities are generally the shareholders in these companies. (See table on page 628.)

Sea-plane bases are at Konstanz, Rangsdorf-bei-Berlin, Sellin/Rügen, Stettin and Weser *Seeflughafen*, while the sheds and mooring mast of the *Deutsche Zeppelin-Reederei* are at Frankfurt a.M.

Airship Services

Prior to 1935, the development of airship services was in the hands of the *Luftschiffbau Zeppelin G.m.b.H.*; in that year, D.L.H. formed with the parent company a concern known as the *Deutsche Zeppelin-Reederei.*

The first regular airship service was operated in 1931, when a line was opened between Frankfurt a.M. and Rio de Janeiro, and this continued until 1937. The service carried both passengers and mails, and by the end of 1935, when two airships were in operation, 103 crossings of the South Atlantic had been made. In 1935, 1,429 passengers and 14·2 tons of mail and freight were carried. It is not possible to give figures for the service in 1936, as the airship and D.L.H. returns for the Atlantic services are grouped together as *Tranzozeandienst*. Experiments were

The following table summarizes the activity of the various airports in 1937:

Airport	Aircraft arrivals	Passengers arrivals	Transit	Departures	Freight (tons)	Mail (tons)
Bayreuth	58	116	439	88	6·1	0·2
Berlin	71,978	94,624	—	97,085	3,087·4	2,034·6
Borkum	213	1,589	651	1,642	40·0	4·8
Bremen	1,020	5,611	796	4,228	83·1	20·6
Breslau	1,944	6,641	1,106	6,606	117·9	81·6
Brunswick	407	467	1,902	526	15·7	4·4
Chemnitz	361	743	1,150	661	24·0	11·1
Dortmund	1,819	4,435	9,480	4,776	163·2	53·3
Dresden	1,425	3,936	2,592	3,879	135·4	33·2
Düsseldorf	2,090	7,623	1,618	7,902	148·0	45·2
Erfurt	939	1,463	6,228	1,399	87·5	39·7
Essen/Mülheim	2,560	7,913	8,143	8,560	313·3	81·0
Flensburg	215	321	—	276	4·5	0·4
Frankfurt a.M.	7,115	30,424	10,583	29,912	966·2	1,452·5
Freiburg	448	1,385	—	1,466	29·1	6·0
Friedrichshafen	158	833	—	816	15·3	1·5
Gleiwitz	493	1,387	—	1,530	20·8	6·2
Halle/Leipzig	5,285	16,777	25,032	16,820	653·5	333·9
Hamburg	5,016	24,264	4,573	24,697	761·7	247·4
Hanover	4,293	6,938	10,674	7,067	812·1	1,634·7
Hirschberg	281	747	—	645	5·7	—
Karlsruhe	508	844	413	763	20·8	11·4
Kiel	610	1,414	1,177	1,650	39·3	5·8
Köln	6,374	22,690	5,158	22,090	1,273·4	1,274·8
Königsberg	1,432	8,059	232	8,374	268·2	389·7
Langeoog	332	563	1,662	703	26·0	9·0
Magdeburg	581	381	1,006	384	10·7	6·1
Mannheim/Ludwigshafen/Heidelberg	1,985	5,641	1,584	5,595	114·0	65·9
Munich	3,442	23,019	5,965	23,066	788·6	575·5
Münster	265	760	185	772	8·6	3·3
Norderney	282	1,412	903	1,249	32·2	8·0
Nuremberg	3,726	8,502	17,925	8,494	562·0	678·6
Saarbrücken	519	2,319	—	2,274	28·9	15·4
Sellin/Rügen	133	466	—	519	5·4	1·5
Stettin	739	1,483	5,539	1,368	84·9	25·5
Stuttgart	3,255	13,879	4,086	13,357	543·5	254·2
Swinemünde	267	547	533	445	9·0	6·1
Tilsit	132	119	—	148	1·4	1·3
Wangerooge	356	1,280	1,354	1,645	39·1	11·1
Westerland	115	1,163	—	994	23·2	9·9
Wilhelmshaven	218	608	1,126	290	15·0	3·5
Wyk	227	621	1,721	623	30·8	11·7

From: *Statistisches Jahrbuch für das Deutsche Reich, 1938*, p. 245 (Berlin, 1938).

Note: The totals of aircraft arrivals and departures are very nearly similar, so arrivals only are given in this table. The freight and mail figures are the totals for the amounts arriving, departing, and passing through in transit.

carried out on a North Atlantic route between Frankfurt a.M. and Lakehurst (New Jersey, U.S.). In March 1937, the *Hindenburg* was destroyed at her moorings at Lakehurst, and all trans-Atlantic services were suspended. The sister-ship, the

Graf Zeppelin, made a number of trial flights over Germany, but there were no further services, as the company were unable to obtain supplies of helium from the U.S., and hydrogen was considered to be too dangerous for passenger and mail services.

Private Flying

There is in a sense little private flying in Germany, as all flying instruction is carried out by the *Nationalsozialistisches Flieger Korps*, and is an outstanding example of Nazi party activity. In fact, all pilots learn to fly through the N.S.F.K., with the exception of a few D.L.H. pilots who are trained at the companies' own schools. The *Korps* is organized in sixteen regional groups, each with its flying school, usually at one of the big airports which afford facilities for training. Gliding instruction played a prominent part, especially before Germany officially announced air re-armament. The main private flying club is the *Aero-Club von Deutschland*, which is virtually a semi-official body.

Appendix II

POSTS, TELEGRAPHS AND TELEPHONES

Postal and telecommunication services in Germany are vested by the State in the *Reichspost* or German Post Office, which comprises a central administrative body or *Reichspostministerium*, regional offices known as *Direktionen*, and the local executive offices. The first of these is under the direction of a *Reichspostminister*, assisted by a Secretary of State, and it administers all postal and telecommunication services in the Reich except radio broadcasting, the control of which it shares with the *Reichsministerium für Propaganda und Volksaufklärung*. The minister is advised by a special council or *Beirat*, and by the *Reichspostzentralamt*, while there are two research stations at Dresden and Berlin which are concerned with technical aspects of the operation of the telecommunication system. In 1939, Germany was divided into forty-one *Reichspostdirektionsbezirke*, each one being under the control of a *Direktion*; these zones were grouped into a number of larger units in order to facilitate the liaison with the central administration. Since the outbreak of the present war, however, the postal zones have been revised, and the whole of Greater Germany has been divided into thirty-two zones, most of which are identical with the *Reichsgaue* or Party *Gaue*. The local administrative offices or *Postämter* totalled in 1938 some 47,000, of which 3,206 were main offices. The *Reichspost* had nearly 430,000 employees in 1938.

In the first half of the nineteenth century there were many post offices in Germany (see p. 448). The Austro-Prussian postal convention of 1851 led to the passage of other postal conventions and treaties, so that by the end of the fifties the total number of independent postal areas in Germany had been reduced to 17. In 1868 the North German Confederation had achieved a unified postal system north of the river Main, and a uniform ten-pfennig letter charge was introduced—28 years after the introduction of Rowland Hill's penny post in England (1840). The unified Reich of 1871 had a single post office, although Bavaria used its own stamps.

Germany played considerable part in international postal co-operation, and Heinrich von Stephan was one of the chief influences behind the founding of the World Postal Union.

Postal Services

Although formerly the Reichspost provided all the transport facilities required to maintain its services, it now relies to an increasing extent upon the railways and upon sea and air transport companies. Until the re-organization of the German State Railways after the war of 1914–1918, the Reichspost had the right to make free use of railway transport facilities. Payment since then has been made on the basis of axle-kilometres run on behalf of the Reichspost. The wagons used are in some cases railway-owned and sometimes they are Reichspost property, and there is a different scale of charges for the two. At the end of March 1938, there were 3,407 Reichspost rail vans, and 1,873 hired vans in operation; the Reichsbahn covered 565·5 million axle-kilometres on behalf of the Reichspost. Mail is carried in ships leaving German ports in accordance with contracts made with the various shipping companies, with payments on the basis of the weight of mail carried. Special facilities are provided on the train-ferry service between Warnemünde and Gedser and between Sassnitz and Trälleborg. Seven German and four American ships had post-offices on board to accommodate the mail between Germany and the U.S.A. Further, forty-six vessels on the inland waterways and on coastal

services carried mails under contract. Air-mail services are described on p. 624. The Reichspost owns a considerable fleet of motor and other road vehicles, which operate in areas where rail transport is impracticable. As in many European countries, these vehicles provide, in addition to the conveyance of mail, facilities for the transport of passengers and luggage. Other interesting features of the postal transport system include the use of motor-cycles and of battery-driven electric vehicles in the more important towns, and of pneumatic tubes for sending express letters and telegrams between different post-offices in the same town; this service is open to the public in Berlin and Munich.

Letter-post is of course the most extensive of the functions of the Reichspost. Apart from the usual services, mention may be made of one peculiar to Germany, that of the *Postwurfsendungen*, by which printed matter may be sent in bulk without any addresses to determined groups, and the Reichspost arranges for the distribution to individual recipients within the particular class. In 1937, some 177 billion items were distributed by this system. An important feature of the work of the Reichspost is the distribution of newspapers and periodicals; this is, in fact, the normal method of distribution to regular subscribers in Germany, and in 1937 some 1,400 million papers were so delivered. The parcel service handles parcels and packets up to 20 kilograms (44 lbs.) in weight; there are no restrictions with regard to dimensions. The service is generally operated on lines similar to those in the United Kingdom, but as a rule a declaration form must be filled in for all parcels deposited with the post-office. At the request of the sender, parcels may be collected for despatch from private addresses. The *Postgüter* service is intended mainly for the handling of commercial goods in bulk at a reduced rate, but parcels over 7 kg. (15 lbs.) in weight are not accepted.

Postal Banking Facilities

The Reichspost has an extensive system of banking services, including a number of facilities which in the United Kingdom are provided by the banks only. The post offices have a clearing account with the nearest branch of the *Reichsbank*. The *Postchechamt* or Postal Cheque Service is a convenient and popular service designed to facilitate payments of money, and is used extensively by small traders and business men. No interest is paid on deposits, and it was not intended to be a savings bank, the functions of which are performed by the *Postsparkasse*, a system inherited from Austria after the *Anschluss*. In little more than two and a half years the number of depositors had risen to $4\frac{1}{4}$ million and the deposits totalled RM. 1 milliard, but its importance is still small compared with the public savings banks which at the same date had deposits of RM. 30 milliard. A recent service introduced by the Reichspost is that of postal cheques for travellers, which may be cashed at any post-office, at railway station exchanges, and at the *Deutsche-Verkehrs-Kredit-Bank*. The usual postal money-order business is, of course, operated on a large scale, and differs from that in this country in that the money order is despatched not by the sender but by the Reichspost, and the recipient is paid in cash. These postal orders are accepted up to a value of RM. 1,000. Finally, there is a C.O.D. service, whereby goods are delivered C.O.D. up to a maximum value of RM. 1,000.

Air-mail Services

The transport of air-mail in Germany was in the hands of the *Deutsche Lufthansa A.G.* at Berlin (see p. 623), while the *Deutsche Zeppelin-Reederei* at Frankfurt-am-Main also played a small part. The Reichspost minister was represented on the boards of both of these companies. Air-mail was carried on the regular services, and in addition there was a special service of night air-mail between the principal German towns and various European capitals. Special flights were made from

Köln to Cherbourg to catch the liners for America. D.L.H. operated a weekly air-mail service to South America, which connected with services maintained by *Condor*, *Panagra*, and *Lloyd Aero Boliviano*. During the summer months letters and parcels were transported between Frankfurt-am-Main and New York by airship. Details of the routes operated by D.L.H. are given on p. 625.

Telegraphs

The use of the public telegraphic services has been decreasing during the years prior to 1938, although in that year the number of telegrams handled within Germany showed an increase over the total for the previous year. The following table shows the number of telegrams handled in recent years; it should be noticed that this figure includes radio-telegrams, for separate statistics are not published.

Telegram Traffic, 1929–38 (millions)

	Inland service	From foreign countries	To foreign countries	In transit	Total
1929	22·7	7·3	7·5	2·6	40·1
1932	14·1	4·5	4·4	1·4	24·4
1933	14·2	4·1	4·0	1·2	23·5
1934	13·8	3·5	3·4	1·1	21·8
1935	13·7	3·3	3·1	0·9	21·0
1936	14·0	3·5	3·1	0·9	21·5
1937	13·8	3·4	3·0	0·9	21·1
1938	17·8	3·9	3·7	1·1	26·5

From successive volumes of *Statistisches Jahrbuch für das Deutsche Reich* (Berlin).

The number of telegrams handled per 100 of the population thus fell from 47·1 in 1929 to 24·8 in 1937, and increased somewhat to 33·0 in 1938. This decline, in spite of the introduction of new features such as a subscribers' teleprinter service, was due mainly to the increase of the telephone service.

In March 1938, there were in Germany ten main telegraph offices, with twenty-six branch offices and 933 sub-offices. There has been an increasing tendency for telegraphy to utilize the long-distance telephone lines for the transmission of telegrams; in fact, only 82,737 miles of line were exclusively telegraphic, while 246,831 miles were used both for telegraphy and telephony. The various types of line are described on p. 634. The main feature of the technical development of telegraphic communications has been the general replacement of the old types of Morse apparatus by various forms of teleprinter.

The methods employed in Germany for the handling of telegrams are very similar to those in the United Kingdom. In addition, they are transmitted to recipients over special private wires or *Nebentelegraphen* connected with the public service telegraph network, and special arrangements are made for delivery to and despatch from Reichsbahn trains. In order to meet special requirements, there are a number of special categories of telegrams. These include the *Blitz* or urgent telegrams, which receive priority, letter-telegrams (*Brieftelegramme*) at a reduced rate, and the *Schmuckblätter* or greetings telegrams. Two other interesting features are the subscribers' teleprinter service, and the picture and facsimile service. The first of these, or the *Teilnehmer-Fernschreibdienst*, enabled a caller to dial other subscribers and transmit telegraph messages directly to the recipient by means of an automatic switching system. By 1938, switching centres had been opened at Berlin, Dortmund, Hamburg and Nuremberg, with 430 subscribers. The Austrian

system, with Vienna as centre, and with fourteen subscribers, was incorporated into the general system. The picture and facsimile service (photo-telegraphy) was introduced in 1927, and its use has extended steadily. There are also in Germany a number of private photo-telegraphic exchanges, mainly set up by news-agencies.

Submarine Cables

Prior to 1939, the German cable services were controlled from a central telegraph office at Emden, with which most of the important telegraph offices in the country were connected. In addition, the central telegraph office in Berlin had direct cable communication with the *Western Union Telegraph Company* of New York, while the Hamburg office had direct communication with the British *Cable and Wireless Limited*. Fifty-eight cables were in operation in German territorial waters in 1938, between the mainland and the numerous islands, or from one island to another. Three crossed Lake Constance from Friedrichshafen to Romanshorn in Switzerland. There were also nineteen international cables owned and operated by the Reichspost, some in conjunction with other countries; these cables were laid between Germany and Great Britain, Denmark, Norway, Sweden, the Netherlands and Danzig. The British *Cable and Wireless Limited* operated a cable between Borkum and Dumpton Gap, Margate. The German company, *Deutsche-Atlantische Telegraphengesellschaft*, owned three cables, from Borkum to Dumpton Gap, to Vigo in Spain, and to Horta in the Azores.

Radio-telegraphic Services

Radio-telegraphic messages from Germany to other countries are despatched from the central transmitting station at Königswusterhausen, which is under the direct control of the central telegraphic office in Berlin. Incoming messages are received at Berlin-Zehlendorf. Long-distance overseas cables are transmitted from the station at Nauen, and received at Beelitz. At the beginning of 1938, direct radio-telegraphic communication had been established with most European countries and with the Americas, Egypt, Iran, Burma, the East Indies, China and Japan.

The number of radio-telegrams (excluding those handled by the special maritime and aircraft stations, which are described on p. 635), handled in recent years, were as follows:

Radio-telegram Traffic, 1932–7 (thousands)

	European		Extra-European		Total
	Outgoing	Incoming	Outgoing	Incoming	
1932	548	694	343	320	1,905
1933	561	695	350	323	1,929
1934	526	685	344	316	1,871
1935	506	637	370	271	1,784
1936	549	677	425	360	2,011
1937	495	568	423	311	1,797

From successive volumes of *Statistisches Jahrbuch für das Deutsche Reich* (Berlin).

Telephones

The German telephonic system was operated in 1938 by just over 7,000 exchanges of which about 4,100 were automatic. It was claimed that 88% of the telephone subscribers were connected to automatic exchanges, a figure higher than that of

any other European country. In March 1938, there were 3,623,697 stations in operation, of which just over 2 million were private subscribers' stations. The steady increase in the number of stations is shown in the following table:

Telephone Stations, 1930–8 (thousands)

	Private subscribers' stations	Extensions	Public stations	Total
1930	1,937	1,198	69	3,204
1933	1,740	1,137	83	2,960
1934	1,727	1,142	84	2,954
1935	1,829	1,221	84	3,134
1936	1,896	1,229	84	3,270
1937	1,972	1,373	86	3,431
1938	2,064	1,473	87	3,624

From successive volumes of *Statistisches Jahrbuch für das Deutsche Reich* (Berlin).

The average telephone density in Germany in 1937 was 5·1 telephones per 100 inhabitants, which had risen to 5·3 by March 1938, a figure which may be compared with those of the U.S.A. (14·4), Great Britain (5·9), Belgium (4·3), and France (3·5). The towns with the highest densities were Berlin (13·3), Stuttgart (11·2), Munich (11·0), Hamburg (10·5), Düsseldorf (10·4), Frankfurt-am-Main (10·3), and Münster (9·9). It is interesting to note that some of the larger industrial towns, such as Essen (5·2), Dortmund (4·8), and Beuthen (3·3), had very low figures compared with the big cities.

As has been stated above, long-distance cables are used jointly by both telephone and telegraph services. The following table, which differentiates between the different types of line in use, gives the lengths of line in 1938 used by the telephonic service alone, and that used by both:

Telephone Stations, 1930–8 (1,000 miles)

	Telephone circuits	Telephone and telegraph circuits
Open-wire circuits	1,518	170
Overhead circuits	590	7
Underground	14,984	67
Submarine	49	3
Total	17,141	247

From official sources.

It will be seen that underground cables comprise a large proportion of the total length of line. The network is divided into two categories, local and trunk. The former, as usual, connects subscribers to the local exchange or one local exchange to another. The trunk circuits mainly connect the various trunk exchanges of the local networks. Other trunk circuits include switching circuits, which connect to a trunk exchange local exchanges in an area where there is no trunk exchange; direct circuits, which provide continuous communication between two points, usually in the neighbourhood of large towns; and the comparatively uncommon 'Sp' circuits, which connect a number of public telephones to a nearby trunk exchange.

The use made by the public of the telephone service has grown steadily in recent years, as shown in the following table:

Telephone Traffic, 1933–8 (millions)

	Local calls	Trunk calls	Total
1933	1,953·3	230·4	2,165·7
1934	1,943·2	235·4	2,178·6
1935	2,040·8	250·5	2,291·3
1936	2,168·2	267·5	2,435·7
1937	2,277·5	286·4	2,563·9
1938	2,417·8	306·1	2,723·9

From successive volumes of *Statistisches Jahrbuch für das Deutsche Reich* (Berlin).

All telephone calls are graded on a priority basis, there being six categories. The order of priority is as follows: (1) *Staatsgespräche* or Government calls; (2) *Blitzgespräche* or emergency calls; (3) *Dringende Ferngespräche* or urgent private trunk calls; (4) *Ferngespräche* or trunk calls; (5) *Schnellgespräche* or short-distance trunk calls, rather like the British 'toll' calls; and (6) *Ortsgespräche* or local calls. As a rule, conversations are interrupted in order to make way for a call of higher priority. Other special services include the *N-Gespräche*, which are short messages sent by telephone to a post office or exchange, and are then delivered in writing, and the *Auftragsdienst*, which performs such services as alarm calls at a certain hour.

Special Radio Services

The special radio services operated in Germany include, in addition to the radiotelegraphic services described on p. 636, (1) aeronautical and aircraft stations dealing with the transmission of telegrams to and from aircraft, and (2) various types of coastal radio stations, including those on German ships.

(1) *Aeronautical and aircraft stations.* In 1938, there were thirty-two aeronautical stations in operation at airfields in Germany. Some of these were simply direction-finding stations, others enabled radio-telephonic communication to be maintained between the aircraft and their bases and transmitted meteorological and other technical information. A number admitted public as well as official radiotelegrams for transmission to passengers in aircraft. There was a considerable number of stations in aircraft dealing with the transmission and reception of radiotelegrams and of radio-telephonic messages, totalling 384 in 1938. Most of these were in D.L.H. (see p. 625) and private machines, with one station in the *Graf Zeppelin.* In 1937, 562 public radio-telegrams were exchanged between aircraft and ground stations.

(2) *Maritime Radio Stations.* The following table summarizes the number of maritime radio stations in operation during 1938 and 1939:

Station	March, 1938	March, 1939
Coastal stations, including light-ships	34	35
Radio Beacons	13	14
Fixed directional beam stations	6	6
Radio stations on German merchant ships	1,155	1,244
Directional beam stations on German merchant ships	858	1,025
Ships with radio-telephonic transmission apparatus	282	381
Ships with broadcast receiving apparatus	328	335

From: (i) *The Admiralty List of Radio Signals*, Volume II (H.M.S.O., London, 1942); (ii) other official sources; (iii) *Statistisches Jahrbuch für das Deutsche Reich*, 1938, p. 247 (Berlin, 1939.)

The extent of the radio-telegraphic and -telephonic services in 1937 is shown in the following table, which, however, does not include radio navigational warnings and ice signals:

Service	Number
Communication through German coastal stations with ships' stations:	
(*a*) Outgoing telegrams	34,375
(*b*) Incoming telegrams	144,514
(*c*) Conversations	5,421
Ships' letter telegrams received through German coastal stations	13,469
News bulletins transmitted by maritime radio service	2,212
From German radio stations at sea:	
(*a*) Telegrams	189,000
(*b*) Ocean letters	9,700
(*c*) Conversations	2,200
(*d*) Ships' letter telegrams	4,000

From official sources.

These German coastal stations which provide public maritime services come under the direction of the Reichspost. Responsibility for those installed on ships rests with the shipping companies, under the jurisdiction of the Reichspost, although the actual operation is undertaken under contract by the *Deutsche Betriebsgesellschaft für drahtlose Telegraphie*, known as *Debeg*, which holds a virtual monopoly of these services.

Various navigational bulletins, such as warnings, meteorological reports, tidal signals and ice reports, are transmitted from the stations at Norddeich, Wilhelmshaven, Elbe-Weser, List and Rügen, immediately on receipt of the information, again at certain fixed times, and on request. Ice reports are also broadcast when necessary by the broadcasting stations at Bremen, Flensburg, Hamburg, Hanover, Magdeburg, Stettin, Heilsberg and Königsberg.

Germany's direction-finding stations operate continuously on 375 kilo-cycles per second, and are used for calling, determining and communicating bearings. The control station for the North Sea is at Nordholz, with other stations at Borkum and List; the control station for the Baltic is Swinemünde, with others at Arkona and Stolpmünde.

Radio beacons, most of which radiate a characteristic signal at certain fixed intervals and a constant transmission during periods of fog, are mostly situated on light-vessels, with the exception of those stations at Stubbenkammer and Pillau, and at the Warnemünde and Swinemünde lighthouses.

Time signals, intended primarily for ships at sea, are broadcast by the long-distance radio station at Nauen and by the German broadcasting station *Deutschlandsender*.

Note on Time

The standard time normally adopted in Germany is that of the Central European zone, that is, one hour fast on Greenwich.

Appendix III

SHIPPING TONNAGE AND MEASUREMENT

The figure of tonnage quoted for ships are of four kinds: displacement, deadweight, gross register tonnage, and net register tonnage. Displacement tonnage and dead weight tonnage are computed in units of weight—avoirdupois tons in Great Britain. Gross and net register tonnage are computed in units of measurement.

Displacement Tonnage

Displacement tonnage is employed invariably for warships, having been in use since 1872. It represents the actual weight of water displaced by the ship at a given draught, i.e. the actual weight of the fabric and everything aboard. It is evaluated by computing the volume of sea water displaced, in cubic ft., and dividing by 35 to obtain tons. For displacement in fresh water the volume is divided by 36. Displacement represents the greatest tonnage figure which can be quoted against a ship. It is rarely employed for merchant ships. Since the Washington Conference of 1921–22 the actual figure for warships has been given as '*standard displacement*', i.e. total weight except for fuel and reserve feed water.

Deadweight Tonnage

Deadweight tonnage is the maximum weight of cargo (excluding cargo of exceptionally high or low density), fuel and stores which can safely be carried by a ship at load draught. It is frequently quoted for cargo ships as an indication of their size for purposes of trade, e.g. in connexion with the building programmes. It can be regarded as the freight-earning capacity of a ship, subject to variations arising from the nature of the cargo and of the voyage.

Displacement minus deadweight = lightweight (or weight of the fabric).

Gross and Net Tonnage

These figures are entered on the register of shipping in the country of ownership, and for this reason they are often referred to as *gross register tonnage* and *net register tonnage*. In Great Britain 'register tonnage' is held in law to be *net* register tonnage. Sometimes net and gross register tonnage are referred to on the continent as 'new measurement'.

Net tonnage is the basis for the assessment of port dues in all countries, and of light dues for ships trading to Great Britain. Net and gross tonnage also form a basis for negotiation among brokers and underwriters. Furthermore, figures of net tonnage entered and cleared are usually quoted in statistics of traffic compiled by port authorities.

Gross (*register*) *tonnage* and *net* (*register*) *tonnage* are expressed in units of measurement, and not of weight; the 'ton' was originally the 'tun', a measure of capacity in the wine trade. A gross or net ton is a measurement of space calculated from the average bulk of light freight or 'measurement cargo'.

Measurements and computations in this country are carried out by Board of Trade Surveyors. The methods of measurement and the rules for carrying them out differ somewhat in various countries. The chief rules for the measurement of merchant ships are (1) English rule, (2) old German rule, (3) Danubian rule, (4) Suez Canal rule, (5) Panama Canal rule. In fact, however, the English rule is generally followed, save for certain differences which occur in some countries. These differences may apply to the general computations of gross tonnage, as in

Sweden, or to the methods of making allowances for net tonnage, as with the old German rule for the computation of net tonnage, which is in force in Sweden, Belgium and Chile. Owing to these differences in computation, it is generally held that totals of net tonnage in Swedish and Belgian statistics, for both ship and port statistics need to be reduced by an average of 20·6% and 15% respectively for comparison with the statistics of other countries. An investigation made in 1934 even showed that Belgian figures should be reduced by 18%. The British rules are those laid down by the Merchant Shipping Acts of 1854 and 1894, as amended slightly in 1906.

Sometimes a vessel arriving in a country, in which the standard differs appreciably from the standard applied in the country of origin, is examined by a surveyor and the tonnage computed according to the national standard. British ships arriving in Sweden for the first time are partially re-measured to entitle them to a Swedish certificate; Swedish ships are usually measured in Sweden for British tonnage as well as for Swedish. The certificates of tonnage of the following countries, with or without qualifications, have been accepted by the British government: Belgium*, Denmark*, Estonia, Finland*, France*, Germany*, Greece, Iceland, Italy*, Japan*, Latvia, Netherlands*, Norway*, Portugal*, Spain*, Sweden*, U.S.A., U.S.S.R.* Ships of other countries trading with this country must, therefore, be measured by the Board of Trade on arrival. The countries shown in the above list with an asterisk, together with Danzig and Great Britain, are those of which the gross and net register tonnage are accepted in the U.S.A. (except the Panama Canal).

Gross Tonnage

Working from the 'tonnage deck' (the upper deck in all ships which have less than three complete decks, and the second deck from the bottom in all other ships) established formulae are used to determine the cubical capacity of the ship in ft. Divided by 100 this becomes the *register underdeck tonnage*. Upper deck capacities are added, and the result, subject to certain deductions (e.g. of structures for sheltering passengers on the top deck), gives the *gross register tonnage*. If the cubical capacity is computed in cubic metres, then division by 2·83 will give the tonnage.

Gross tonnage is sometimes employed as the unit in classifying ships for purposes of legislation, e.g. M.S. (Wireless Telegraphy) Act 1919.

Net Tonnage

When deduction from the gross tonnage is made for all spaces occupied by propelling machinery, navigating equipment, crew's quarters, double bottom and water ballast tanks, the result is the *net register tonnage*, equivalent to the amount of space in the ship which can be devoted to cargo. A tug, therefore, could have a net tonnage of 0, because of the great amount of space taken up by the propelling machinery. Generally speaking the faster the ship, the higher is the gross/net percentage; slow cargo ships have a low gross/net percentage.

Suez and Panama tons. The Suez Canal Company and the United States Government apply special methods of computing the tonnage of ships which pass through the canals. Each method, by including more superstructure than is customary, arrives at a higher figure for gross and net tonnage than the figures on the register. The canal computations are higher than the British figures as follows:

Suez: gross 5%; net 30% approximately.

Panama: gross 10%; net 30% approximately.

These figures are applied irrespective of flag.

Relations between Tonnage Figures

There is no general formula to express the relation between displacement, dead-weight, gross and net, for it varies according to the type and build of the ship, the

speed it is designed for, and many other factors. For example, a fast steamship and a slow steamship of the same displacement would have different net tonnages owing to the greater space taken up by the propelling machinery space in the former.

Cargo ships. For a medium cargo steamship, of standard construction and about 390 ft. in length, the following figures would be representative:

Displacement . .	11,500	Gross . . .	5,200
Deadweight . .	8,000	Net . . .	3,200
Lightweight . .	3,500		

It is possible, however to establish the relationship between all the tonnage figures in ships of closely similar type. For cargo steamers of standard form and of the full scantling type, with erections covering 50% of the length, for example, the relationship is as follows:

Underdeck, gross, deadweight and displacement tonnage as a percentage of net tonnage

Length of ship in ft.	Tonnage				
	Net	Underdeck	Gross	Deadweight	Displacement
250	100	140	166	255	378
300	100	144	161	250	356
400	100	143	158	235	322
500	100	138	159	213	317

Gross and deadweight tonnage as a percentage of net tonnage for 3,448 *British ships, June* 1936

C: Coasting Trade; F: Foreign Trade.

Type	Trade	Net	Gross	Dwt.	No. of ships examined
Tramps	C	100	196	269	620
	F	100	164	281	950
Cargo Liners	C	100	219	260	244
	F	100	163	233	823
Passenger Liners	C	100	242	28	52
	F	100	172	89	44
Mixed Passenger and Cargo Liners	C	100	226	92	88
	F	100	171	148	283
Tankers	C	100	181	205	37
	F	100	169	256	307
All Types	C	100	209	217	1,041
	F	100	166	224	2,407
All Ships	C & F	100	168	224	3,448

From: Isserlis, L., 'Tramp Shipping Cargoes and Freights', *Journ. Royal Statistical Society,* vol. 101, p. 63 (London, 1938).

In a warship the gross tonnage approximates to an average of 60% of the standard displacement.

In mercantile shipping circles, however, the tonnage normally dealt with is gross, net and deadweight. A rough formula in use is 'Deadweight = $2\frac{1}{2}$ times net'; a better and more comprehensive formula, employed for many years, is '100 *net tons* = 160 *gross tons* = 240 *deadweight tons*'. The relationship between tonnage measurements for various classes of ships in service may be studied in a calculation based upon 3,448 British ships in service in 1936 (see p. 639).

The relation between deadweight and net tonnage changes with progress in ship design and with the demands of trade. Between 1914 and 1936, for example, the number of deadweight tons per 100 tons net for British foreign-going tramps rose from 264 to 281, and for British foreign-going tankers from 234 to 256. In the same period, however, for cargo liners the figure dropped from 247 to 233, owing to the necessity of providing refrigerated cargo space and additional space for propelling machinery arising from the higher speeds expected. Other factors affect the position, too: following an agreement relating to load lines in 1932, it was found that British tankers were permitted to sail with less freeboard than formerly.

Some examples of tonnage measurements for British and foreign ships illustrate the variations shown by specific types of ship.

S: Steamship; M: Motorship.

		Type	Gross tonnage	Net tonnage	Deadweight tonnage (cargo and bunkers)	Permanent bunker capacity tons	Loaded draught on summer freeboard ft. in.	No. of tons per 100 net. Gross	Dwt.
Corfell	S	Collier	1,802	1,016	2,650	150	17 4	180	265
King Alfred	S	Tramp	5,272	3,188	8,400	630	25 3	168	262
Amerikaland	M	Ore Cr.	15,337	4,385	22,780	—	—	348	518
Chilore	S	,, ,,	8,310	4,565	22,200	1,800	—	182	486
British Corporal	S	Tanker	6,972	4,075	10,800	1,500	27 8	171	265
Shéhérezade	M	,,	13,467	7,015	18,530	520	30 9	192	265
C. O. Stillman	M	,,	13,006	7,765	24,000	—	—	167	308
Westland	M	Cargo Lr.	5,888	3,548	9,300	2,020	25 6	168	262
Dominion Monarch	M	P. & C. Lr.	27,155	15,813	22,700	5,360	34 1	171	143
Nieuw Amsterdam	S	,,	36,287	21,496	10,300	—	31 6	168	48
Queen Mary	S	P. Lr.	81,235	34,120	17,400	—	38 10	238	51
Normandie	S	,, ,,	83,423	36,985	14,400	—	36 7	225	39

The ore carrier *Amerikaland* has exceptional measurement figures because the ship was designed to carry no other cargo but iron ore; owing to the high specific gravity of the cargo the cargo space was very restricted and thus the net tonnage was very low for the deadweight. An ordinary tramp carrying only iron ore would have the greater part of its cargo space empty.

It is important to distinguish the type of measurement employed, especially in connexion with shipping losses and construction programmes. It would be true to say that a million tons of shipping lost is replaced by a million tons of construction only if the same units are employed throughout. Thus, with standard cargo ships of 3,200 net tonnage and 8,000 tons deadweight, a million tons of shipping would mean 312 ships if net tonnage were implied, but only 192 if gross tonnage were implied and only 125 if deadweight tonnage were implied.

Measurement Capacity

A further system of measurement, by volume, gives the true cubic capacity of

holds, or what amount of 'light measurement' goods can be carried (i.e. of any goods which might ever fill the holds of a normal cargo ship), e.g.

Cubic capacity of holds
,, ,, ,, bale space
,, ,, ,, grain
Capacity bale space (tons of 40 cub. ft.)

Equivalents

English	*French*	*Italian*	*German*
Gross	Lourd (*or* brut)	Lordo	Brutto
Net	Tonnage net (*or* jauge nette)	Netto	Netto
Deadweight	Enlourd (*or* poids mort)	Peso morto	Totes Gewicht

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A standard work is Blocksidge, E. W., *Hints on the Register Tonnage of Merchant Ships* (Liverpool, 1933). Other informative studies are: the *Admiralty Navigation Manual*, vol. I (London, 1938); Isserlis, L., 'Tramp Shipping Cargoes and Freights', *Journ. Royal Statistical Society*, vol. 101, pp. 53–134 (London, 1938); Johnson, D. R., *Modern Dock Operation* (London, 1929); Paasch, *From Keel to Truck, Dictionary of Naval Terms* (5th ed., London, 1937); *Kempe's Engineering Yearbook* (London, annually); *Encyclopaedia Britannica*, arts. 'Shipping: Registration, Classification and State Regulation'; 'Shipping: Tonnage Terms' (London, New York, 1929); *Rotterdam: Statistiek van Handel, etc.*, 1938, p. 17 (Rotterdam, n.d.).

Appendix IV

LINER TRAFFIC

'It is a fallacy of the nursery, which still persists in the average adult, to think that a "liner" is necessarily a vessel with two or more funnels and a dance band.' Liners, broadly speaking, are vessels which operate to a schedule: their ports of departure and arrival, and dates of sailing are arranged in advance and can be advertised. They offer space mainly for general cargo and for certain cargoes requiring specialized equipment. Such vessels may be passenger liners carrying a little cargo, passenger-cargo liners, cargo liners taking some passengers, and cargo liners not taking passengers. The liner category excludes tramps, which do not sail to a schedule, and which are offered in the chartering market for such cargoes as may require space. It excludes also, cargo vessels specially built for a particular commodity, such as tankers, ore carriers, vessels built to carry railway engines and rolling stock, etc., as well as those vessels which, while not built in specialized style, are owned by concerns for the purposes of carrying their own commodities.

The freight carried by liners makes up what is usually called the merchandise or general cargo trade, to distinguish it from the bulk cargoes of tramps and tankers. General cargo includes all packed and crated goods, e.g. fruit in cases, machinery, and a considerable proportion of heavy goods like baled cotton or bagged grain. Vessels equipped with chambers for keeping goods such as bananas, meat, or butter at a given temperature are usually liners. A number of liners have some space for carrying vegetable oil in bulk, others may often have part of their cargo space filled with a bulk commodity, e.g. bulk grain. Such cargo is often accepted as 'make-weight' cargo. Grain, and other cereals, especially wheat and rice, are carried in large quantities by liners, as are cotton, timber and sugar. Raw cotton from the southern states of U.S.A. reaches Europe in normal times by way of liners from southern ports or from New York after transhipment there. There is a good deal of overlap between liner and tramp cargoes, but the two leading tramp cargoes (coal and ores) are rarely found in liners. Other important tramp cargoes are wheat, timber, sugar, maize, fertilizer, rice, cotton, wood pulp, rye, oats, barley, stone, sulphur, and oilseeds. It is not unusual for a liner company to charter a tramp to put on loading berth in an emergency. (See table at top of page 643.)

Apart from bulk liquid cargoes carried in tankers, which are vessels of a specialized function, the precise distribution of sea-borne cargo between tramps and liners is not known. An American authority writing in 1926 says, 'Since liners carry miscellaneous package cargo, it is impossible even to estimate the weight of such articles . . . Tramp ships were considered to outnumber liners before the war.* The popular idea was that two-thirds of the ships of the world were tramps and only one-third liners. The idea was incorrect, but tramp ships made up at least between 30% and 40% of the tonnage of the world. . . . To-day at least 80% of the shipping space for the carriage of cargo is offered by liners.' Comparisons, therefore, can be made only in terms of cargo space. The same authority gives the statement of the distribution of tramp and liner tonnage over the main lines of shipping movement in 1922. (See table at bottom of page 643.)

The proportion has been changing in favour of the liner, for the cargo liner made considerable progress in the period 1919–39. The variety of goods entering into world trade is increasing, and certain specialized trades—fruit in particular—have expanded very greatly. The liner, especially the cargo liner, has received a good

* i.e. before 1914.

Type of Ship employed in bringing certain cargoes to German or near-German ports, 1936–8

Origin	*Destination*	*Cargo*	*Ship*
Montreal	Eng., Cont.	Grain	Tramp
U.S. Atlantic	Hamburg	,,	Liner
,, ,,	,,	Lard	,,
,, ,,	,,	Copper	,,
,, Norfolk	Bremen	Cotton	,,
,, New Orleans	,,	,,	,,
North Pacific	Eng., Cont.	Grain	Tramp
Guatemala	Hamburg	Coffee	Liner
Cuba	Eng., Cont.	Sugar	Tramp
Bahia	Hamburg	Tobacco	Liner
Rio de Janeiro	,,	Bran	,,
Buenos Aires	,,	Wool	,,
San Lorenzo	Eng., Cont.	Grain	Tramp
Bahia Blanca	,, ,,	,,	,,
Chile	Hamburg	Saltpetre	Liner
Karachi	Bremen	Cotton	Liner
Madras	Hamburg/Bremen	Ground Nuts	,,
Calcutta	,,	Jute	,,
Rangoon	,,	Rice	,,
Singapore	Hamburg	Rubber	,,
Philippines	,,	Copra	,,
Dairen	,,	Soya beans	,,
S. Australia	Eng., Cont.	Wheat, bagged	Tramp
W. Australia	,, ,,	Wheat, bulk	,,
Nicolaevsk, Poti	N. sea ports	Manganese ore	,,
Huelva	Rotterdam	Ore	,,
England, E. coast	Hamburg	Coal	,,

From: *Statistisches Jahrbuch, etc.*, 1938, p. 124 (Berlin, 1938).

Clearances of Ships with Cargo, 1922 (*in thousands of net tons*)

Route	Total	Liners	% Liners
N. America—Europe	25,832	20,796	80
N. America—S. America	2,016	1,709	85
N. America—S. Africa	294	208	72
N. America—Australia	845	652	77
N. America—Asia via Suez and Panama Canals	1,390	1,205	94
N. America Pacific Coast—Asia	2,852	2,139	75
Europe—Asia (Suez Canal)	6,384	6,107	95
Europe—S. and W. Africa	1,926	1,519	80
Europe—Australia	2,060	1,802	87
Europe—S. America	5,918	4,379	74
	49,517	40,516	82

From: Gregg, E. S., 'Ocean Trade Routes', *The Geographical Review*, vol. 16, pp. 291–5 (New York, 1926).

deal of encouragement by the governments of various countries, for the establishment of the line from home ports to foreign destinations is an effective way of assisting home exporters. The establishment of lines has at times formed a component in commercial treaties.

Published 'loading lists' provide information concerning dates of sailing, ports of departure and ports of destination. In order to maintain a regular service over a long route, a liner owner must, as a rule, employ a fleet of ships, representing a considerable capital investment. A liner usually costs twice or three times as much as a tramp of similar size. If calls are made at a large number of ports, port charges amount to a considerable sum. The operation of a line requires an elaborate organization of special berths, skilled stevedoring and a wide network of brokers and agents. These heavier costs mean, therefore, that liner freights are higher than tramp freights. A differential tariff is applied to the enormous variety of commodities carried, a tariff which is arrived at only after long experience of the needs and prospects of various trades.

Liner freights are governed by agreements between the companies concerned in particular routes, agreements which are established at 'liner conferences'. 'Conference' rates apply both where the primary object is passenger trade and where it is cargo trade. Tramp freight rates, on the other hand, fluctuate according to the availability of cargo space offering at ports where it is in demand. The closure of the St Lawrence ports during the winter and the seasonal nature of the wheat movement are examples of factors which influence rates for tramp cargoes. A port with a permanent excess of inward tramp cargoes will have low outward rates because of the competition for freight; a port with an outward excess will have higher outward rates, because of the shortage of cargo space and the need for vessels to be brought from other ports in ballast.

A chief reason for the operation of liner schedule is the opportunity given to a shipper to choose the most advantageous sailing for his particular consignment. Thus an exporter of machinery at Stuttgart wishing to dispatch a consignment to Santos may have the choice between (i) vessels leaving Hamburg and calling at Antwerp, or calling at Bremen or Rotterdam as well as, or instead of, Antwerp, (ii) vessels sailing from Rotterdam and calling at Antwerp, and (iii) vessels sailing from Antwerp. In choosing a port of despatch the shipper will be influenced largely by the time at his disposal and the cost of rail transport.

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CONVERSION TABLES

Metric and British Units

It is customary to think of the 'metre' and the 'yard' as representing unalterable units of length. This is not so. The metre was originally intended to be the 10,000,000th part of the earth's meridional quadrant. But the accurate determination of this length proved to be extremely difficult—partly for technical reasons, and partly because of different conceptions of the 'figure of the earth'. In view of these difficulties it became necessary to define the length of the metre in terms of suitable metal bars measured under specified conditions of temperature, pressure, humidity, etc. Similar standard bars were also used to define the length of other units such as the yard. As all these metallic standards are subject to change, conversion tables differ according to the date of comparison between different bars. The tables that follow are based on the comparison between the yard and the metre made in 1895. This made 1 metre equivalent to 39·37013 in.

Metric System. List of Prefixes

Deca means ten times.	Deci means a tenth part of.
Hecto means a hundred times.	Centi means a hundredth part of.
Kilo means a thousand times.	Milli means a thousandth part of.

In abbreviation the Decametere, etc., is Dm., and the decimetre, etc., dm.

Note on 'Nautical', 'Geographical' and 'Statute' miles

A British 'nautical mile' is the length of the minute of the meridian at any given latitude and is therefore a variable unit. It is given in feet for Clarke's 1880 spheroid by the formula:

$$60771{\cdot}1 - 30{\cdot}7 \cos 2 \text{ Lat.}$$

This is the sea mile of the scale of latitude and distance of the Admiralty Charts. From the above formula it will be found to vary from 6,046·4 ft. at the equator to 6,107·8 ft. at the poles, being 6,077·1 ft. at latitude 45°.

The so-called 'international nautical mile' of 1,852 m. or 6,076 ft. is the length of the minute of the meridian at latitude 45° on the international spheroid. This corresponds to the 6,077 ft. for Clarke's spheroid.

A 'geographical mile' is a fixed unit, being defined by some as the length of a minute of the equator and by others as that of the minute of the meridian at latitude 45°. According to the former definition its value on Clarke's spheroid is 6,087 ft. and according to the latter 6,077 ft. The round figure 6,080 is usually adopted for the purposes of ordinary navigation.

The British 'statute mile' measures 5,280 ft.

List of Conversion Tables

Table 1. *Length*

Nautical mile	Statute mile	Kilometre	Metre	Yard	Foot	Inch	Centimetre
1	1·152	1·853	1,853	2,027	6,080*	72,960	185,300
0·8684	*1*	1·60934	1,609·34	1,760	5,280	63,360	160,934
0·5396	0·621372	*1*	1,000	1,093·61	3,280·84	39,370·1	100,000
0·0005396	0·0006214	0·001	*1*	1·09361	3·28084	39·3701	100
0·0004934	0·0005682	0·0009144	0·914399	*1*	3	36	91·4399
0·0001645	0·0001894	0·0003048	0·3048	0·33333	*1*	12	30·48
0·0000137	0·0000158	0·0000254	0·0254	0·02778	0·083333	*1*	2·54
0·0000054	0·0000062	0·00001	0·01	0·0109361	0·032808	0·393701	*1*

* This is the customary British practice, and not the 'international nautical mile', which Great Britain has not adopted.

Table 2. *Area*

Square mile	Square kilometre	Hectare	Acre	Square metre	Square yard
1	2·58998	258·998	640	2,589,980	3,097,600
0·386103	*1*	100	247·106	1,000,000	1,195,990
0·003861	0·01	*1*	2·47106	10,000	11,959·9
0·0015625	0·0040469	0·404685	*1*	4,046·85	4840
0·00000039	0·000001	0·0001	0·000247	*1*	1·19599
0·00000032	0·00000084	0·0000836	0·000207	0·836126	*1*

Table 3. *Yield per Unit Area*

Tons per acre	Metric tons per hectare	Quintals per hectare
1	2·51071	25·1071
0·398294	*1*	10
0·0398294	0·1	*1*

Table 4. *Volume and Capacity*

Kilolitre	Cubic metre	Cubic yard	Bushel	Cubic feet	Imp. gall.	Litre	Pint
1	1·000027	1·30799	27·4969	35·3157	219·976	1,000	1,759·80
0·999973	*1*	1·30795	27·4962	35·3148	219·970	999·973	1,759·75
0·764532	0·764553	*1*	21·0223	27	168·178	764·532	1,345·43
0·0363677	0·0363687	0·0475685	*1*	1·28435	8	36·3677	64
0·028316	0·028317	0·037037	0·778602	*1*	6·22882	28·3160	49·8306
0·0045460	0·0045608	0·0059461	0·125	0·160544	*1*	4·54596	8
0·001	0·001000	0·001308	0·027497	0·035316	0·219976	*1*	1·75980
0·0005682	0·0005863	0·0007433	0·015625	0·020068	0·125	0·56824	*1*

Table 5. *Weight*

Ton	Metric ton or millier	Quintal	Kilogram	Pound
1	1·01605	10·1605	1,016·05	2,240
0·984207	*1*	10	1,000	2,204·62
0·0984207	0·1	*1*	100	220·462
0·0009842	0·001	0·01	*1*	2·20462
0·0004464	0·0004536	0·004536	0·453592	*1*

Table 6. *Temperature: Equivalent of Fahrenheit and Centigrade Scales*

° F.	° C.	° F.	° C.	° F.	° C.	° F.	° C.	° F.	° C.	° F.	° C.
100	37·7	79·25	26·25	58	14·4	37·4	3	17	− 8·3	− 4	− 20
99·5	37·5	79	26·1	57·2	14	37	2·7	16·25	− 8·75	− 5	− 20·5
99	37·2	78·8	26	57	13·8	36·5	2·5	16	− 8·8	− 5·8	− 21
98·6	37	78	25·5	56·75	13·75	36	2·2	15·8	− 9	− 6	− 21·1
98	36·6	77	25	56	13·3	35·6	2	15	− 9·4	− 6·25	− 21·25
97·25	36·25	76	24·4	55·4	13	35	1·6	14	− 10	− 7	− 21·6
97	36·1	75·2	24	55	12·7	34·25	1·25	13	− 10·5	− 7·6	− 22
96·8	36	75	23·8	54·5	12·5	34	1·1	12·2	− 11	− 8	− 22·2
96	35·5	74·75	23·75	54	12·2	33·8	1	12	− 11·1	− 8·5	− 22·5
95	35	74	23·3	53·6	12	33	0·5	11·75	− 11·25	− 9	− 22·7
94	34·4	73·4	23	53	11·6	32	0	11	− 11·6	− 9·4	− 23
93·2	34	73	22·7	52·25	11·25	31	− 0·5	10·4	− 12	− 10	− 23·3
93	33·8	72·5	22·5	52	11·1	30·2	− 1	10	− 12·2	− 10·75	− 23·75
92·75	33·75	72	22·2	51·8	11	30	− 1·1	9·5	− 12·5	− 11	− 23·8
92	33·3	71·6	22	51	10·5	29·75	− 1·25	9	− 12·7	− 11·2	− 24
91·4	33	71	21·6	50	10	29	− 1·6	8·6	− 13	− 12	− 24·4
91	32·7	70·25	21·25	49	9·4	28·4	− 2	8	− 13·3	− 13	− 25
90·5	32·5	70	21·1	48·2	9	28	− 2·2	7·25	− 13·75	− 14	− 25·5
90	32·2	69·8	21	48	8·8	27·5	− 2·5	7	− 13·8	− 14·8	− 26
89·6	32	69	20·5	47·75	8·75	27	− 2·7	6·8	− 14	− 15	− 26·1
89	31·6	68	20	47	8·3	26·6	− 3	6	− 14·4	− 15·25	− 26·25
88·25	31·25	67	19·4	46·4	8	26	− 3·3	5	− 15	− 16	− 26·6
88	31·1	66·2	19	46	7·7	25·25	− 3·75	4	− 15·5	− 16·6	− 27
87·8	31	66	18·8	45·5	7·5	25	− 3·8	3·2	− 16	− 17	− 27·2
87	30·5	65·75	18·75	45	7·2	24·8	− 4	3	− 16·1	− 17·5	− 27·5
86	30	65	18·3	44·6	7	24	− 4·4	2·75	− 16·25	− 18	− 27·7
85	29·4	64·4	18	44	6·6	23	− 5	2	− 16·6	− 18·4	− 28
84·2	29	64	17·7	43·25	6·25	22	− 5·5	1·4	− 17	− 19	− 28·3
84	28·8	63·5	17·5	43	6·1	21·2	− 6	1	− 17·2	− 19·75	− 28·75
83·75	28·75	63	17·2	42·8	6	21	− 6·1	0·5	− 17·5	− 20	− 28·8
83	28·3	62·6	17	42	5·5	20·75	− 6·25	0	− 17·7	− 20·2	− 29
82·4	28	62	16·6	41	5	20	− 6·6	− 0·4	− 18	− 21	− 29·4
82	27·7	61·25	16·25	40	4·4	19·4	− 7	− 1	− 18·3	− 22	− 30
81·5	27·5	60	16·1	39·2	4	19	− 7·2	− 1·75	− 18·75	− 23	− 30·5
81	27·2	60·8	16	39	3·8	18·5	− 7·5	− 2	− 18·8	− 23·8	− 31
80·6	27	60	15·5	38·75	3·75	18	− 7·7	− 2·2	− 19	− 24	− 31·1
80	26·6	59	15	38	3·3	17·6	− 8	− 3	− 19·4	− 24·25	− 31·25

Table 7. *Pressure: Equivalents of Millibars, Millimetres of Mercury, and Inches of Mercury at 32° F. in Latitude 45°*

Mercury in.	Milli-bars	Mercury mm.	Mercury in.	Milli-bars	Mercury mm.	Mercury in.	Milli-bars	Mercury mm.	Mercury in.	Milli-bars	Mercury mm.	Mercury in.	Milli-bars	Mercury mm.
27·02	915	686·3	27·82	942	706·6	28·62	969	726·8	29·41	996	747·1	30·21	1,023	767·3
27·05	916	686·1	27·85	943	707·3	28·65	970	727·6	29·44	997	747·8	30·24	1,024	768·1
27·08	917	687·8	27·88	944	708·1	28·67	971	728·3	29·47	998	748·6	30·27	1,025	768·8
27·11	918	688·6	27·91	945	708·8	28·70	972	729·1	29·50	999	749·3	30·30	1,026	769·6
27·14	919	689·3	27·94	946	709·6	28·73	973	729·8	29·53	1,000	750·1	30·33	1,027	770·3
27·17	920	690·1	27·97	947	710·3	28·76	974	730·6	29·56	1,001	750·8	30·36	1,028	771·1
27·20	921	690·8	28·00	948	711·1	28·79	975	731·3	29·59	1,002	751·6	30·39	1,029	771·8
27·23	922	691·6	28·03	949	711·8	28·82	976	732·1	29·62	1,003	752·3	30·42	1,030	772·6
27·26	923	692·3	28·05	950	712·6	28·85	977	732·8	29·65	1,004	753·1	30·45	1,031	773·3
27·29	924	693·1	28·08	951	713·3	28·88	978	733·6	29·68	1,005	753·8	30·48	1,032	774·1
27·32	925	693·8	28·11	952	714·1	28·91	979	734·3	29·71	1,006	754·6	30·51	1,033	774·8
27·35	926	694·6	28·14	953	714·8	28·94	980	735·1	29·74	1,007	755·3	30·53	1,034	775·6
27·38	927	695·3	28·17	954	715·6	28·97	981	735·8	29·77	1,008	756·1	30·56	1,035	776·3
27·41	928	696·1	28·20	955	716·3	29·00	982	736·6	28·80	1,009	756·8	30·59	1,036	771·1
27·44	929	696·8	28·23	956	717·1	29·03	983	737·3	29·83	1,010	757·6	30·62	1,037	777·8
27·46	930	697·6	28·26	957	717·8	29·06	984	738·1	29·86	1,011	758·3	30·65	1,038	778·6
27·49	931	698·3	28·29	958	718·6	29·09	985	738·8	29·89	1,012	759·1	30·68	1,039	779·3
27·52	932	699·1	28·32	959	719·3	29·12	986	739·6	29·92	1,013	759·8	30·71	1,040	780·1
27·55	933	699·8	28·35	960	720·1	29·15	987	740·3	29·94	1,014	760·6	30·74	1,041	780·8
27·58	934	700·6	28·38	961	720·8	29·18	988	741·1	29·97	1,015	761·3	30·77	1,042	781·6
27·61	935	701·3	28·41	962	721·6	29·21	989	741·8	30·00	1,016	762·1	30·80	1,043	782·3
27·64	936	702·1	28·44	963	722·3	29·24	990	742·6	30·03	1,017	762·8	30·83	1,044	783·1
27·67	937	702·8	28·47	964	723·1	29·26	991	743·3	30·06	1,018	763·6	30·86	1,045	783·8
27·70	938	703·6	28·50	965	723·8	29·29	992	744·1	30·09	1,019	764·3	30·89	1,046	784·6
27·73	939	704·3	28·53	966	724·6	29·32	993	744·8	30·12	1,020	765·1	30·92	1,047	785·3
27·76	940	705·1	28·56	967	725·3	29·35	944	745·6	30·15	1,021	765·8	30·95	1,048	786·1
27·79	941	705·8	28·59	968	726·1	29·38	995	746·3	30·18	1,022	766·6	30·98	1,049	786·8

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